AFOEHL REPORT 89-098EQ0144HEF

Boiler Emission Compliance Survey
Norton AFB CA

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Final Report

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AF Occupational and Environmental Health Laboratory (AFSC)
Human Systems Division
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NOTICES

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

At the request of USAF Clinic/SGPB, Norton AFB and HQ MAC/SGPB, compliance testing (carbon monoxide and oxides of nitrogen) of emissions from three Norton AFB boilers was conducted on 17-29 April 1989. Testing was performed to determine compliance with regards to the newly adopted Rule #1146 of the South Coast Air Quality Management District. In anticipation of further regulation, particulate emissions were also determined. Results show that none of the boiler emissions meet the 40 ppm limit for oxides of nitrogen but all meet the 400 ppm limit for carbon monoxide emissions.

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I. INTRODUCTION

On 17-29 April 1989, compliance emission testing for carbon monoxide (CO), oxides of nitrogen (NO_x) and particulate emissions was conducted at Norton AFB on three boilers by personnel of the Air Quality Function of the Air Force Occupational and Environmental Health Laboratory (AFOEHL). This survey was requested by USAF Clinic Norton/SGPB through HQ MAC/SGPB to determine compliance status with regards to newly adopted Rule #1146 of the South Coast Air Quality Management District (SCAQMD). Personnel involved with on-site testing are listed in Appendix A. SCAQMD Rule #1146 is presented in Appendix B.

II. DISCUSSION

A. Background

On 25 Oct 1988 Norton AFB requested that the AFOEHL determine the carbon monoxide and oxides of nitrogen emission compliance status of three boilers with respect to the newly adopted Rule #1146. In order to maximize the benefit of our visit, we were also tasked to determine the particulate emissions in anticipation of further regulation. The boilers in buildings 249 and 672 were each tested once. Boiler number 4 in building 716 was tested twice utilizing natural gas and then diesel #2 as fuels.

To demonstrate and maintain compliance with SCAQMD Rule #1146, Norton AFB requested AFOEHL assistance to: (1) determine carbon monoxide emissions from each boiler as specified in 40 CFR 60, Appendix A, Reference Method 10, and (2) determine the oxides of nitrogen emissions from each boiler as specified in 40 CFR 60, Appendix A, Reference Method 7, and for additional information (3) determine perticulate emissions from each boiler as specified in 40 CFR 60, Appendix A, Reference Methods 1-5.

B. Site Description

A total of three boilers were tested for compliance status with regards to SCAQMD Rule #1146 (Table 1):

Table 1. Boiler Information

Boiler No./ Manufacturer	Fuel	Size
Bldg 672 #1 Ajax Boiler Co.	Natural Gas	5-10 million BTU/hr
Bldg 249 #1/ Kewanee Scotch Generator	Natural Gas	5-10 million BTU/hr
Bldg 716 #4/ Erie City Iron Works	Natural Gas or Oil	> 10 million BTU/hr

The water jacket type boilers are used intermittently, depending on demand, to produce steam and water. Steam/hot water had to be vented/ discharged from the boilers during the tests to maintain constant operation. Sampling ports were installed prior to the arrival of the survey team.

Boiler No. 1, located in building 672 (Figure 1), produces hot water for an adjacent aircraft washrack. Since the boiler works on an intermittent demand schedule, hot water had to be continuously discharged through the washrack to maintain uninterrupted high-fire operation while testing was in progress. Sampling ports were located approximately 0.5 stack diameters upstream of the stack outlet and 4 stack diameters downstream of the boiler.

Boiler No. 1, located in building 249 (Figure 2), produces steam for the Photo Processing Lab complex. Since this boiler also works on an intermittent demand schedule, steam had to be continuously vented through safety valves to maintain uninterrupted high-fire operation while testing was in progress. Sampling ports were located approximately 6 stack diameters upstream of the stack outlet and 2 stack diameters downstream of the nearest airflow obstruction.

Boiler No. 4, located in building 716, produces hot water for much of the main base. Since this boiler also works on an intermittent demand schedule, steam had to be continuously vented through safety valves to maintain uninterrupted high-fire operation while testing was in progress. Sampling ports were located approximately 2 stack diameters upstream of the stack outlet and 3 stack diameters downstream of the nearest airflow obstruction. This boiler was tested twice utilizing different fuels: natural gas and fuel oil. Natural gas is the normal fuel, however, fuel oil is available as a backup.

Gaseous discharge from building 716 boiler No. 4 stack was found to have cyclonical flow with an average rotation angle of 21.6 degrees. Since applicable test methods require that the rotation angle be 20 degrees or less, this condition had to be corrected by installing temporary straighteners before testing could be conducted. Straighteners made from sheet metal were fashioned and installed by Mr Frank Sage and his crew. After modification the average rotation angle was found to be in compliance with the test method criteria.

C. Applicable Limits

The limits identified in SCAQMD Rule #1146 along with the applicable compliance dates are presented in Table 2.

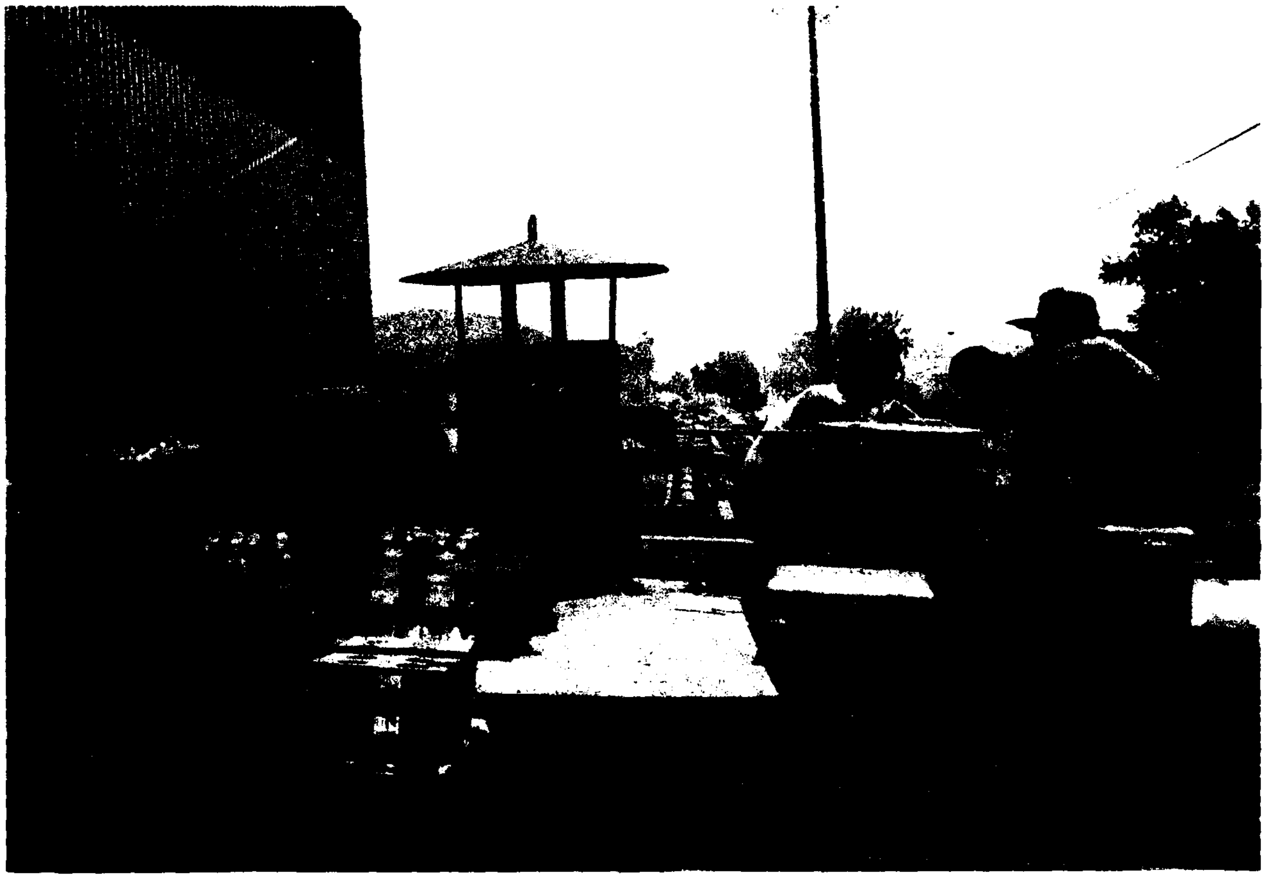

Figure 1. Boiler Stack During Testing, Bldg 672

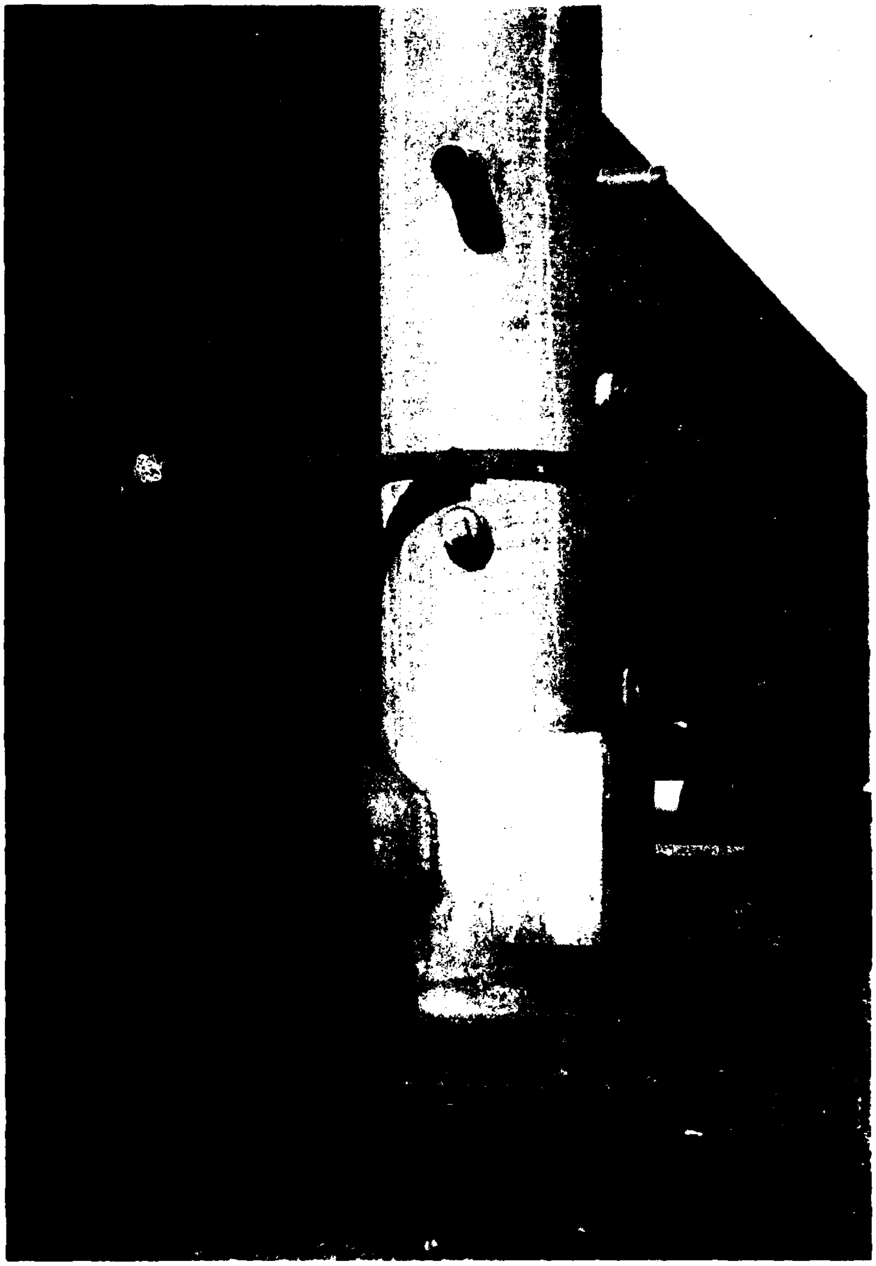

Figure 2. Boiler Stack, Bldg 249

Table 2. SCAQMD Rule #1146 Standards

Boiler	Appliable Standard	Compliance Date
Bldg 672 #1	NO_x - 40 ppm CO - 400 ppm	1 Mar 92
Bldg 249 #1	NO_x - 40 ppm CO - 400 ppm	1 Mar 92
Bldg 716 #4	NO_x - 40 ppm CO - 400 ppm	1 Sep 91

D. Sampling Methods and Procedures

The SCAQMD Rule #1146 requires that all emissions tests be conducted in accordance with the procedures and analytical methods specified in 40 CFR 60, Appendix A, Methods 1-5, 7 and 10. Therefore, test methods, equipment, sample train preparation, sampling and recovery, calibration requirements, and quality assurance were done in accordance with the methods and procedures outlined in 40 CFR 60, Appendix A.

The boiler exhaust stack, in each of the three cases, was a straight duct. Sampling ports were already in place and met the minimum standards for method 1. Based on the port location, stack diameter and type of sample (particulate), a maximum of 24 traverse points were used for each emission evaluation.

Particulate samples were collected using the sampling train shown in Figure 3. The train consisted of a buttonhook probe nozzle, heated inconel probe, heated glass filter, impingers, and pumping and metering device. The nozzel was sized prior to each test so that the gas stream could be sampled isokinetically; in other words, the velocity of the gas at the nozzel tip was the same as the stack gas velocity at each point sampled. Flue gas velocity pressure was measured at the nozzle tip, using a Type-S pitot tube connected to a 10-inch inclined-vertical manometer.

Type K thermocouples were used to measure flue gas and sampling train temperatures. The probe and filter were heated to minimize moisture condensation. The heated filter was used to collect particulate material. The impinger train (first, third, and fourth impingers were modified Greenburg-Smith type; the second impinger was a standard Greenburg-Smith design) acted as a condenser to collect stack gas moisture. The pumping and metering system was used to control and monitor the flue gas flow rate as well as the sampling rate.

Each sampling run lasted 60 minutes; therefore, the sampling time for each of the 24 traverse points was 2.5 minutes. These sample times were applicable for all runs. All runs were within the required isokinetic rate.

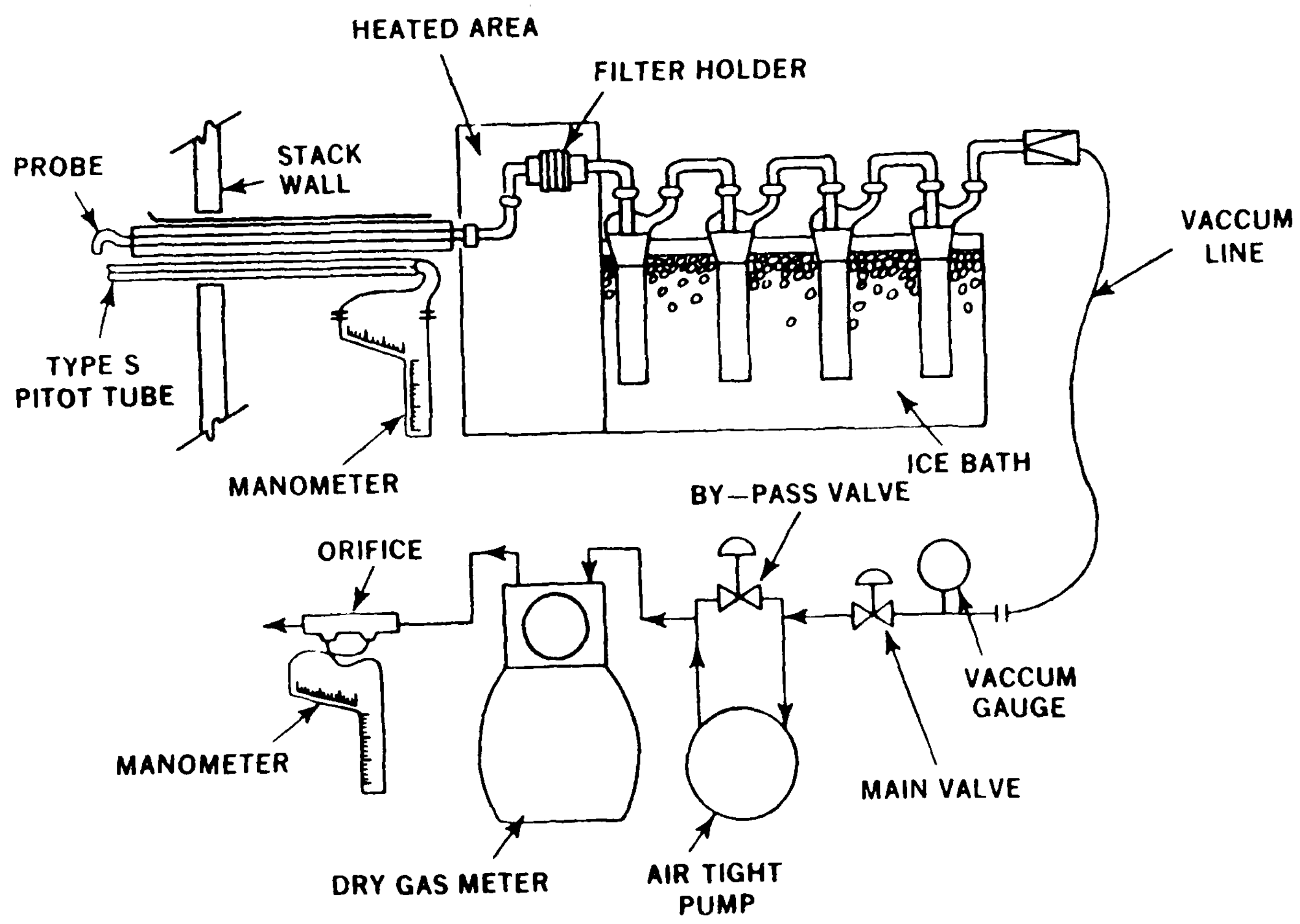

Figure 3. Particulate Sampling Train

Prior to each sample run on a stack, a preliminary velocity pressure traverse was accomplished and cyclonic flow was determined. For acceptable flow conditions to exist in a stack, the average of the absolute value of the flow angle (cyclonicity) taken at each traverse point must be less than or equal to 20 degrees. The flow angle for the boilers located in buildings 672, 249 and 716 were 7.6, 5.4, and 6.5 (after modification), respectively.

During each sample run, a flue gas grab sample for ORSAT analysis (measures oxygen and carbon dioxide for stack gas molecular weight determination and emissions correction) was taken. ORSAT sampling and analysis equipment are shown in Figures 4 and 5. Flue gas moisture content, also needed for determination of gas molecular weight, was obtained during particulate sampling.

Emission calculations were done using "Source Test Calculation and Check Programs for Hewlett-Packard 41 Calculators" (EPA-340/1-85-018) developed by the EPA Office of Air Quality Planning and Standards, Research Triangle Park NC. This is our standard method for calculating emissions data. Calibration data are presented in Appendix I.

Oxides of nitrogen samples were collected using the sampling train shown in Figure 6. The train consisted of a glass probe packed with glass wool and wrapped with a heating system, T-bore stopcocks, 2-Liter flask, vacuum gauge, squeeze bulb, and evacuation pump. The sample is removed by a grab sampling technique. It is captured in a 2-Liter flask which has been evacuated and contains an absorbing solution of hydrogen peroxide and sulfuric acid. The absorbing solution converts the NO_x (except nitrous oxide (N_2O)) in the captured gas to nitric acid (HNO_3) in solution. NO_x sampling was conducted concurrently with particulate sampling. Type K thermocouples were used to measure the sample temperature. Calibration Data are presented in Appendix I.

Carbon monoxide samples were collected using the sampling train shown in Figure 7. The train consisted of a stainless steel sample probe packed with glass wool, a condenser, a rotometer, a sample bag, an evacuation container and evacuation pump. An integrated sample was collected by evacuating the evacuation container, which caused a negative pressure, pulling a sample into the sample bag. The rate of flow into the sample bag was monitored and adjusted (using the evacuation pump) to remain proportional to the stack flowrate. Prior to connecting the sample bag to the probe, the probe was purged with stack gases. Calibration data are presented in Appendix I.

III. CONCLUSIONS

1. Particulate Emission Rate (EPA Method 5)

Table 3 provides the particulate emission rates determined from these tests. Results indicate the three runs conducted on boiler 716/4 utilizing fuel oil emitted approximately five times the particulates generated by the three runs which used natural gas. However, the emission levels for all the tests were low and should not cause the base any problems. Calculations for particulate emissions are presented in Appendix H.

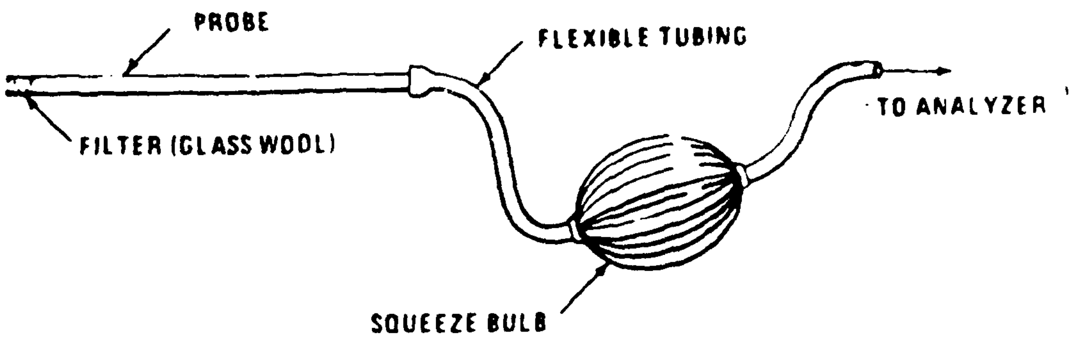

Figure 4. ORSAT Grab Sampling Train

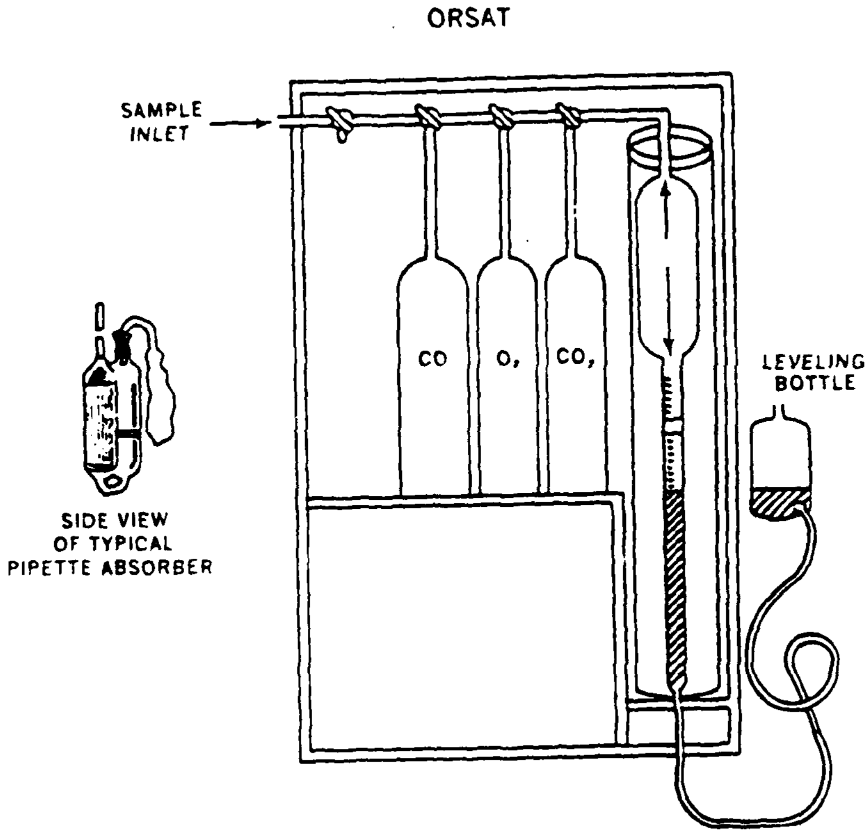

Figure 5. ORSAT Apparatus

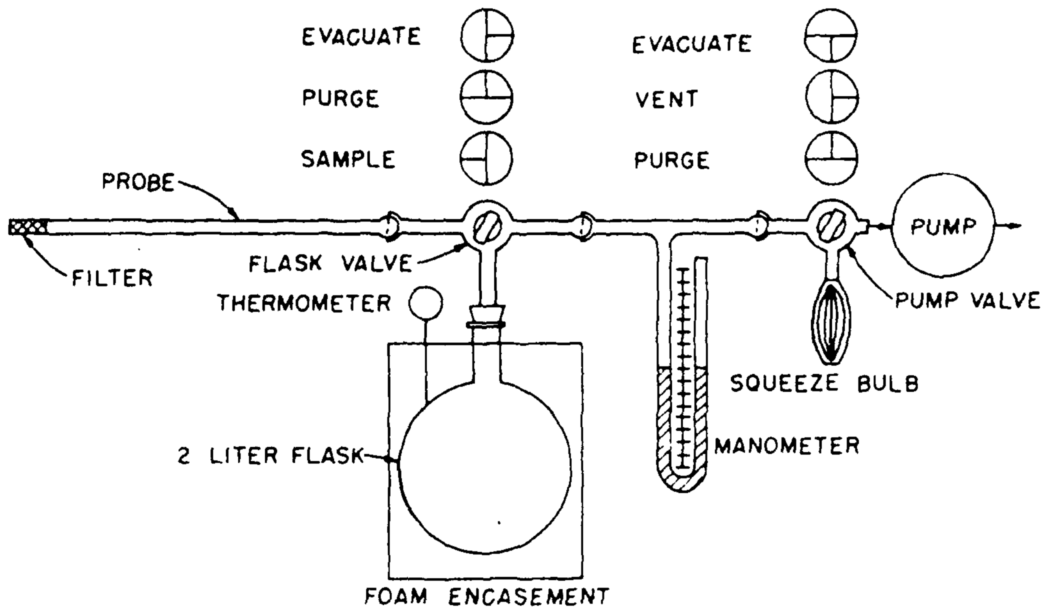

Figure 6. Sampling Train for Oxides of Nitrogen

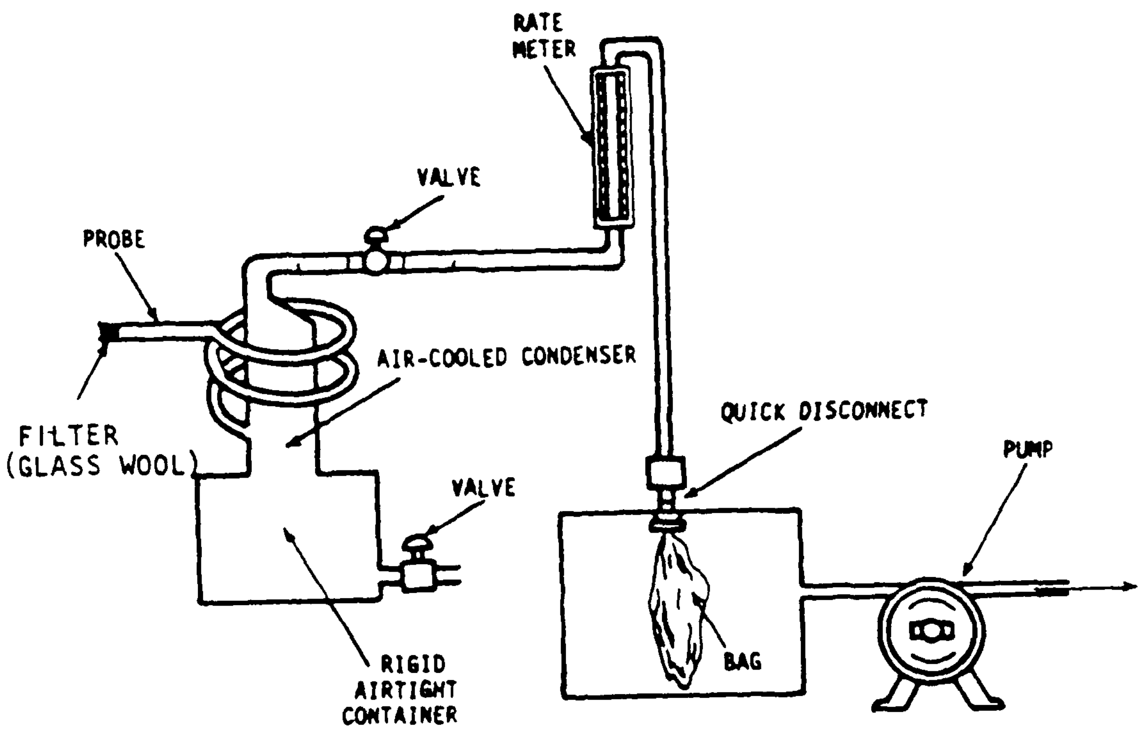

Figure 7. Carbon Monoxide Sampling Train

Table 3. Stack Emission Particulate Test Results

Date	Boiler No.	Run No.	Particulate Emissions (gr/dscf)	(mg/m^3)	(lb/hr)	(kg/hr)
19 APR 89	672/1	1	3.2998E-6	0.0076	0.0001	2.5454E-5
20 APR 89	672/1	2	2.1580E-6	0.0049	3.4479E-5	1.5640E-5
20 APR 89	672/1	3	2.2852E-6	0.0052	3.5101E-5	1.5922E-5
Average of Runs 1,2,3			2.5810E-6	0.0059	5.6526E-5	1.9005E-5
24 APR 89	249/1	1	2.3241E-6	0.0053	3.3506E-5	1.5198E-5
24 APR 89	249/1	2	1.6322E-6	0.0037	2.2426E-5	1.0172E-5
24 APR 89	249/1	3	1.5729E-6	0.0036	2.1450E-5	9.7296E-6
Average of Runs 1,2,3			1.8431E-6	0.0042	2.5794E-5	1.1700E-6
27 APR 89	716/4[1]	1	4.5218E-6	0.0103	0.0002	0.0001
27 APR 89	716/4[1]	2	2.7274E-6	0.0062	0.0001	0.0001
27 APR 89	716/4[1]	3	2.8044E-6	0.0064	0.0001	0.0001
Average of Runs 1,2,3			3.3512E-6	0.0076	0.0001	0.0001
28 APR 89	716/4[2]	1	1.6523E-5	0.0378	0.0007	0.0003
28 APR 89	716/4[2]	2	1.7848E-5	0.0408	0.0008	0.0004
28 APR 89	716/4[2]	3	1.6095E-5	0.0368	0.0007	0.0003
Average of Runs 1,2,3			1.6822E-6	0.0385	0.0007	0.0003

Note: gr/dscf = grains per dry standard cubic foot
mg/m^3 = milligrams per cubic meter
lb/hr = pounds per hour
kg/hr = kilograms per hour
1 = natural gas burned as fuel
2 = diesel fuel #2 burned as fuel

2. Carbon Monoxide (EPA Method 10)

Table 4 provides the carbon monoxide emission concentrations determined from these tests. Results indicate that carbon monoxide emissions from the third run conducted on boiler 716/4 (utilizing natural gas as a fuel) did not meet the limit of 400 ppm. However, this is of little consequence since the average of three runs constitutes one test. The average of the three runs, 197.72 ppm, was well below the standard. All other boiler emissions were found to be well below the SCAQMD Rule #1146 limit of 400 ppm. Calculations for carbon monoxide emissions are presented in Appendix H.

Table 4. Stack Emission Carbon Monoxide Test Results

Date	Boiler No.	Run No.	Concentration CO_2 (percent)	Conc. CO (ppm)	Conc. Corrected CO (ppm)	Average
19 Apr	672/1	1	4.3	10	9.57	
20 Apr	672/1	2	7.0	10	9.30	
20 Apr	672/1	3	7.0	10	9.30	9.39
24 Apr	249/1	1	6.0	<10	<9.40	
24 Apr	249/1	2	5.2	<10	<9.48	
24 Apr	249/1	3	5.6	<10	<9.44	9.44
27 Apr	716/4[1]	1	9.0	65	59.15	
27 Apr	716/4[1]	2	7.0	10	9.31	
27 Apr	716/4[1]	3	9.0	570	518.70	195.72
28 Apr	716/4[2]	1	10.4	<10	<8.96	
28 Apr	716/4[2]	2	10.0	<10	<9.00	
28 Apr	716/4[2]	3	9.0	<10	<9.10	9.02

note: 1 = natural gas burned as fuel
2 = diesel fuel #2 burned as fuel

3. Oxides of Nitrogen (EPA Method 7)

Table 5 provides the oxides of nitrogen emission concentrations determined from these tests. Results show that emissions from all boilers tested do not meet the SCAQMD Rule #1146 limit of 40 ppm. Further, the burning of diesel fuel #2 in boiler 716 produced 83 percent more NO_x than the burning of natural gas. Conditions which favor NO_x formation are high flame temperature, long residence time and excess oxygen. Calculations for oxides of nitrogen emissions are presented in Appendix H.

Two methods of reducing NO_x emissions are to change fuels and/or modify the combustion system. As can be seen in Table 5, gas combustion produces the least NO_x emissions. An obvious combustion modification for NO_x control is to reduce excess air. This will reduce NO_x formation from nitrogen found in the air. Reducing combustion temperature will lower NO_x formation from nitrogen found in the fuel itself. Reduction of combustion temperature can be accomplished by: (1) eliminating "hot spots" in the combustion gases where rapid mixing of fuels and air occur; (2) reducing rate of combustion by reducing fuel rate or load; and, (3) recirculating flue gas (acts as heat sink to reduce temperature). Although this may cause effluent CO concentration levels to rise, the initial CO concentrations (10-200 ppm) are low compared to the standard (400 ppm).

Table 5. Stack Emission NO_x Test Results

Date	Boiler No.	Run No.	Concentration NO_x (ppm)	Average Concentration
19 Apr	672/1	1	45	
20 Apr	672/1	2	42	
20 Apr	672/1	3	41	43
24 Apr	249/1	1	38	
24 Apr	249/1	2	41	
24 Apr	249/1	3	45	41
27 Apr	716/4[1]	1	75	
27 Apr	716/4[1]	2	56	
27 Apr	716/4[1]	3	53	62
28 Apr	716/4[2]	1	113	
28 Apr	716/4[2]	2	107	
28 Apr	716/4[2]	3	110	110

note: 1 = natural gas used as fuel
2 = diesel fuel #2 burned as fuel

IV. RECOMMENDATIONS

We recommend that each boiler be retested with the operational parameters such as flame temperature and excess oxygen decreased to retard NO_x formation.

References

1. "Standards of Performance for New Stationary Sources," Title 40, Part 60, Code of Federal Regulations, July 1, 1987.

2. Quality Assurance Handbook for Air Pollution Measurement Systems - Volume III, Stationary Source Specific Methods, U.S. Environmental Protection Agency, EPA-600/4-77-027-b, Research Triangle Park, North Carolina, December 1984.

3. Source Test Calculation and Check Programs for Hewlett-Packard 41 Calculators. U.S. Environmental Protection Agency, EPA-340/1-85-018, Research Triangle Park, North Carolina, May 1987.

4. Brenchly, D.L., et al, "Industrial Source Sampling," Ann Arbor Science Publishers Co., Ann Arbor, Michigan, 1973.

APPENDIX A

PERSONNEL INFORMATION

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List of TDY Personnel

1. AFOEHL Sampling Team:

   Maj James A. Garrison, Chief, Air Quality Function
   Capt Ronald W. Vaughn, Consultant, Environmental Quality
   1Lt Charles W. Attebery, Consultant Environmental Quality
   1Lt Ali Y. Ali, Consultant, Industrial Hygiene
   Sgt Robert P. Davis, Technician, Environmental Quality
   Sgt Harrold D. Casey, Technician, Environmental Quality

2. Norton AFB On-Site Representatives:

   Capt Richard Matta, USAF Clinic/SGPB
   2Lt Krista Wenzel, USAF Clinic/SGPB
   Mr Frank Sage, 63 CES/DEMUH

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APPENDIX B

South Coast Air Quality Management

District Rule No. 1146

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(Adopted September 9, 1988)

RULE 1146. EMISSIONS OF OXIDES OF NITROGEN FROM INDUSTRIAL, INSTITUTIONAL AND COMMERCIAL BOILERS, STEAM GENERATORS, AND PROCESS HEATERS

(a) Definitions

(1) Annual Heat Input means the actual amount of heat released by fuels burned in a unit during a calendar year.

(2) Boiler or Steam Generator means any combustion equipment fired with liquid and/or gaseous fuel and used to produce steam or to heat water and that is not used exclusively to produce electricity for sale. Boiler or Steam Generator does not include any waste heat recovery boiler that is used to recover sensible heat from the exhaust of a combustion turbine or any unfired waste heat recovery boiler that is used to recover sensible heat from the exhaust of any combustion equipment.

(3) BTU means British thermal unit.

(4) Heat Input means the chemical heat released due to fuel combustion in a unit, using the higher heating value of the fuel. This does not include the sensible heat of incoming combustion air.

(5) NOx Emissions means the sum of nitric oxides and nitrogen dioxide in the flue gas, collectively expressed as nitrogen dioxide and averaged over a period of 15 minutes.

(6) Process Heater means any combustion equipment fired with liquid and/or gaseous fuel and which transfers heat from combustion gases to water or process streams. Process Heater does not include any kiln or oven used for drying, baking, cooking, calcining, or vitrifying; or any unfired waste heat recovery heater that is used to recover sensible heat from the exhaust of any combustion equipment.

(7) Rated Heat Input Capacity means the heat input capacity specified on the nameplate of the combustion unit. If the combustion unit has been altered or modified such that its maximum heat input is different than the heat input capacity specified on the nameplate, the new maximum heat input shall be considered as the rated heat input capacity.

(8) Therm means 100,000 Btu's.

(9) Unit means any boiler, steam generator, or process heater as defined in subparagraph (2) or (6) of this paragraph.

(b) Applicability

With the exception of boilers used by electric utilities to generate electricity, and boilers and process heaters with a rated heat input greater than 40 million Btu per hour that are used in petroleum refineries, this rule applies to boilers, steam generators, and process heaters used in all industrial, institutional, and commercial operations.

(c) Requirements

(1) The owner or operator of any unit(s) shall not discharge into the atmosphere oxides of nitrogen, expressed as nitrogen dioxide (NO_2), in excess of the concentrations shown in the following table.

Rated Heat Input Capacity		Annual Heat Input	Gaseous or Liquid Fuels
Equal to or greater than 5 million Btu's per hour	And	Greater than 9 x 10^9 Btu's per yr (90,000 Therms)	40 ppm (0.05 lb per 106 Btu's of heat input)

Carbon monoxide (CO) emissions from unit(s) subject to this subparagraph shall not exceed 400 ppm.

(2) Any unit(s) with a rated heat input capacity greater than or equal to 5 million Btu per hour and an annual heat input less than or equal to 9.0 x 10^9 Btu per year shall:

(A) be operated in a manner that maintains stack gas oxygen concentrations at less than or equal to 3 percent on a dry basis for any 15-consecutive-minute averaging period; or

(B) be operated with a stack gas oxygen trim system; or

(C) be tuned at least twice per year, once during the Spring and once during the Autumn, by a technician who is qualified, to the

satisfaction of the Executive Officer, to perform a tune-up in accordance with the procedure described in Attachment 1. The owner or operator of any unit(s) who specifies the semi-annual tune-up option shall submit an annual report verifying that the tune-up has been performed. The report shall contain any other information or documentation that the Executive Officer determines to be necessary; or

(D) be operated in compliance with the applicable emission levels specified in subparagraph (c)(1).

(3) The owner or operator of any unit(s) subject to subparagraph (c)(2) shall submit for the approval of the Executive Officer a plan that demonstrates compliance with subparagraph (c)(2). Such plan shall contain:

(A) A list of all units with the rated heat input capacity and anticipated annual heat input.

(B) For each unit listed, a selection of one of the four options specified in subparagraph (c)(2) to achieve compliance with this rule.

(4) Any unit(s) with a rated heat input capacity greater than or equal to 40 million Btu per hour and an annual heat input greater than 200×10^9 Btu per year, or any units that are part of an Alternative Emission Control Plan, shall have a continuous in-stack nitrogen oxides monitor or equivalent verification system as approved by the Executive Officer. Records shall be maintained and made accessible for a period of two years in a form and manner as specified by the Executive Officer.

(d) Alternative Emission Control Plan

(1) An owner or operator may achieve compliance with paragraph (c) by achieving equivalent nitrogen oxides emissions reductions obtained by alternative control methods provided the applicant submits an Alternative Emission Control Plan that is enforceable by the District and receives approval of the Plan in writing from the Executive Officer prior to implementation. The Alternative Emission Control Plan shall:

(A) Contain, as a minimum, all data, records, and other information necessary to determine eligibility for alternative emission control, including but not limited to:

(i) A list of equipment subject to alternative emission control;

(ii) Daily hours of utilization for applicable equipment;

(iii) Estimated emission of nitrogen oxides for each operation;

(iv) Rated capacity; and

(v) Historical and projected fuel use.

(B) Present the methodology for estimation of equivalency of emission reductions under the proposed Alternative Emission Control Plan as compared to either the emission reductions otherwise required by the rule or to actual emissions, whichever is less.

(C) Demonstrate that the permit units subject to the specified rule emission limitations are in compliance with or on an approved schedule for compliance with all applicable District rules.

(2) Revision of Control Plan

A revised control plan may be submitted by the owner or operator, along with any required permit applications. Such a plan shall adhere to the emissions limits and the final compliance dates of this rule. New units, including functionally identical replacement units, shall not be incorporated into the plan.

(e) Exemptions

(1) To qualify for an exemption from the provisions of subparagraph (c)(1), based on annual heat input, the owner or operator of any unit(s) shall:

(A) install by February 1, 1989 or at the time the unit is constructed, a totalizing meter for each fuel that demonstrates that the unit(s) operated at or below the applicable heat input levels; and

(B) have available for inspection by the Executive Officer by March 1, 1989, and March 1, of each year thereafter, annual fuel use data for the preceding calendar year. Records shall be maintained and made accessible to the Executive Officer for a period of two years.

(2) An exemption granted for any unit will become null and void if that unit operates for one calendar year at an annual heat input greater than the annual applicable heat input levels.

(3) Sulfur plant reaction boilers are exempt from the provisions of this rule.

(f) Compliance Determination

(1) An owner or operator of any unit(s) shall have the option of complying with either the pound per million Btu or parts per million emission limits specified in subparagraph (c)(1).

(2) All emission determinations shall be made in the as-found operating condition, except no compliance determination shall be established during start-up, shutdown, or under breakdown conditions.

(3) All parts per million emission limits specified in paragraph (c) are referenced at 3 percent volume stack gas oxygen on a dry basis averaged over a minimum of 15 consecutive minutes.

(4) Compliance with the NOx emission requirements and the stack gas oxygen concentration requirement of paragraph (c) shall be determined in a manner approved by the Executive Officer.

(g) Compliance Schedule

The owner or operator of units subject to this rule shall meet the following increments of progress:

(1) For owners or operators of units subject to subparagraph (c)(2), submit, by September 1, 1989, a plan pursuant to subparagraph (c)(3) and by March 1, 1990, demonstrate final compliance with subparagraph (c)(2).

(2) For owners or operators utilizing the Alternative Emission Control Plan, pursuant to paragraph (d), by September 1, 1989, submit a control plan.

(3) For owners or operators of units with a rated heat input capacity equal to or greater than 10 million Btu per hour that are subject to subparagraph (c)(1), including those with an approved Alternative Emission Control Plan;

(A) By March 1, 1990, submit required applications for permits to construct and operate.

(B) By September 1, 1991 demonstrate compliance with subparagraph (c)(1) and, if applicable, subparagraph (c)(4).

(4) For owners or operators of units with a rated heat input capacity equal to or greater than 5 million Btu per hour, but less than 10 million Btu per hour, that are subject to subparagraph (c)(1):

(A) By March 1, 1991, submit required applications for permits to construct and operate.

(B) By March 1, 1992, demonstrate compliance with subparagraph (c)(1).

ATTACHMENT 1

Equipment Tuning Procedure[1]

Nothing in this Equipment Tuning Procedure shall be construed to require any act or omission that would result in unsafe conditions or would be in violation of any regulation or requirement established by Factory Mutual, Industrial Risk Insurors, National Fire Prevention Association, the California Department of Industrial Relations (Occupational Safety and Health Division), the Federal Occupational Safety and Health Administration, or other relevant regulations and requirements.

1. Operate the unit at the firing rate most typical of normal operation. If the unit experiences significant load variations during normal operation, operate it at its average firing rate.
2. At this firing rate, record stack gas temperature, oxygen concentration, and CO concentration (for gaseous fuels) or smoke-spot number[2] (for liquid fuels), and observe flame conditions after unit operation stabilizes at the firing rate selected. If the excess oxygen in the stack gas is at the lower end of the range of typical minimum values[3], and if CO emissions are low and there is not smoke, the unit is probably operating at near optimum efficiency - at this particular firing rate.

---

1. This tuning procedure is based on a tune-up procedure developed by KVB, Inc. for the EPA. This procedure is included in Appendix D.

2. The smoke-spot number can be determined with ASTM Test Method D-2156 or with the Bacharach method. ASTM Test Method D-2156 is included in a tuneup kit that can be purchased from the Bacharach Company.

3. Typical minimum oxygen levels for boilers at high firing rates are:
   1. For natural gas: 0.5% - 3%
   2. For liquid fuels: 2% - 4%

However, complete the remaining portion of this procedure to determine whether still lower oxygen levels are practical.

3. Increase combustion air flow to the furnace until stack gas oxygen levels increase by one to two percent over the level measured in Step 2. As in Step 2, record the stack gas temperature, CO concentration (for gaseous fuels) or smoke-spot number (for liquid fuels), and observe flame conditions for these higher oxygen levels after boiler operation stabilizes.
4. Decrease combustion air flow until the stack gas oxygen concentration is at the level measured in Step 2. From this level gradually reduce the combustion air flow, in small increments. After each increment, record the stack gas temperature, oxygen concentration, CO concentration (for gaseous fuels) and smoke-spot number (for liquid fuels). Also observe the flame and record any changes in its condition.
5. Continue to reduce combustion air flow stepwise, until one of these limits is reached:
   a. Unacceptable flame conditions - such as flame impingement on furnace walls or burner parts, excessive flame carryover, or flame instability.
   b. Stack gas CO concentrations greater than 400 ppm.
   c. Smoking at the stack.
   d. Equipment-related limitations - such as low windbox/furnace pressure differential, built in air-flow limits, etc.
6. Develop an O_2/CO curve (for gaseous fuels) or O_2/smoke curve (for liquid fuels) similar to those shown in Figures 1 and 2 using the excess oxygen and CO or smoke-spot number data obtained at each combustion air flow setting.
7. From the curves prepared in Step 6, find the stack gas oxygen levels where the CO emissions or smoke-spot number equal the following values:

Fuel	Measurement	Value
Gaseous	CO Emissions	400 ppm
#1 and #2 oils	smoke-spot number	number 1
#4 oil	smoke-spot number	number 2
#5 oil	smoke-spot number	number 3
Other oils	smoke-spot number	number 4

The above conditions are referred to as the CO or smoke thresholds, or as the minimum excess oxygen level.

Compare this minimum value of excess oxygen to the expected value provided by the combustion unit manufacturer. If the minimum level found is substantially higher than the value provided by the combustion unit manufacturer, burner adjustments can probably be made to improve fuel and air mixing, thereby allowing operation with less air.

8. Add 0.5 to 2.0 percent of the minimum excess oxygen level found in Step 7 and reset burner controls to operate automatically at this higher stack gas oxygen level. This margin above the minimum oxygen level accounts for fuel variations, variations in atmospheric conditions, load changes, and nonrepeatability or play in automatic controls.
9. If the load of the combustion unit varies significantly during normal operation, repeat Steps 1-8 for firing rates that represent the upper and lower limits of the range of the load. Because control adjustments at one firing rate may affect conditions at other firing rates, it may not be possible to establish the optimum excess oxygen level at all firing rates. If this is the case, choose the burner control settings that give best performance over the range of firing rates. If one firing rate predominates, settings should optimize conditions at that rate.
10. Verify that the new settings can accommodate the sudden load changes that may occur in daily operation without adverse effects. Do this by increasing and decreasing load rapidly while observing the flame and stack. If any of the conditions in Step 5 result, reset the combustion controls to provide a lightly higher level of excess oxygen at the affected firing rates. Next, verify these new settings in a similar fashion. Then make sure that the final control settings are recorded at steady-state operating conditions for future reference.

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APPENDIX C

BUILDING 672 BOILER 1 FIELD DATA

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DETERMINATION OF MINIMUM NUMBER OF TRAVERSE POINTS

Stack ID: Bld 672 #1   Stack diameter at ports: 2 (ft)

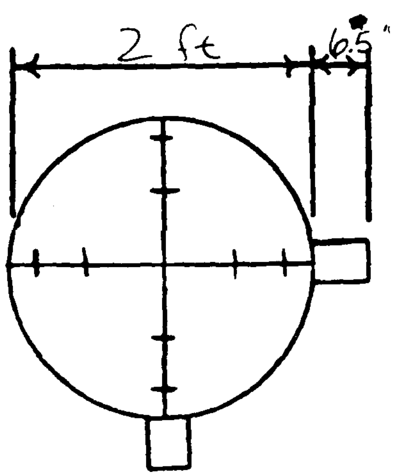
Distance A (ft) 1.5   (duct diameters) 0.75

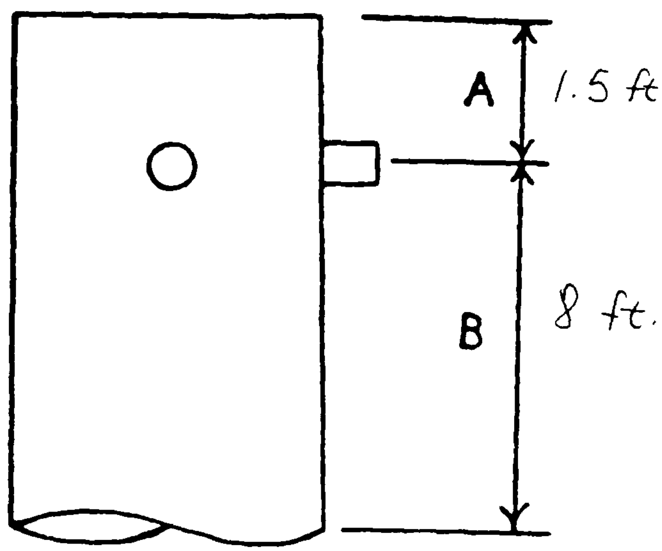
Recommended number of traverse points as determined by distance A: 24

Distance B (ft) 8   (duct diameters) 4

Recommended number of traverse points as determined by distance B: 24

Number of traverse points used: 24





PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE: Norton AFB	DATE: 19 APR 89
BOILER NUMBER: bld 672	
INSIDE STACK DIAMETER: 24"	Inches
STATION PRESSURE: 28.73	In Hg
STACK STATIC PRESSURE: .11	In H20
SAMPLING TEAM: OEHL	

TRAVERSE POINT NUMBER	VELOCITY HEAD, Vp IN H20	α	STACK TEMPERATURE (°F)
1	.075	2	2[illegible]3
2	.08	10	335
3	.08	14	400
4	.08	16	412
5	.08	10	421
6	.08	13	424
7	.085	2	427
8	.085	7	429
9	.09	5	428
10	.09	4	428
11	.09	4	427
12	.08	4	427
	STATIC H2O	(+).11	
	$\overline{\Delta p} = .08$		
	$\overline{FPS} = 21$		
	$\overline{T} = 400$		
	Nozzle:	.4512 → ux .499	
	AVERAGE		

PRELIMINARY SURVEY DATA SHEET NO. 1
(Stack Geometry)

BASE NORTON	PLANT BLDG 672 HOT WATER BOILER
DATE 19 APR 89	SAMPLING TEAM OEHL
SOURCE TYPE AND MAKE	
SOURCE NUMBER BOILER, BLDG 672	INSIDE STACK DIAMETER 24 Inches
RELATED CAPACITY	TYPE FUEL NATURAL GAS
DISTANCE FROM OUTSIDE OF NIPPLE TO INSIDE DIAMETER 6 1/2" Inches	
NUMBER OF TRAVERSES 2	NUMBER OF POINTS/TRAVERSE 12

LOCATION OF SAMPLING POINTS ALONG TRAVERSE

POINT	PERCENT OF DIAMETER	DISTANCE FROM INSIDE WALL *(Inches)*	TOTAL DISTANCE FROM OUTSIDE OF NIPPLE TO SAMPLING POINT *(Inches)*
1		0.5	7.0
2		1.6	8.1
3		2.8	9.3
4		4.3	10.8
5		6.0	12.5
6		8.5	15.0
7		15.5	22.0
8		18.0	24.5
9		19.7	26.2
10		21.2	27.7
11		22.4	28.9
12		23.5	30.0

OEHL FORM APR 78 15

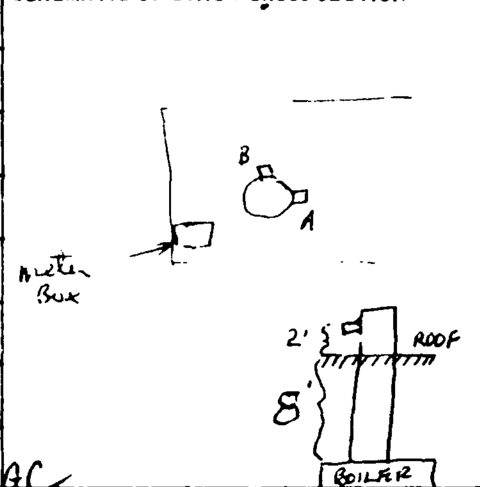
He 1.91

PARTICULATE SAMPLING DATA SHEET

NHT. GAS-FIRED

One of Two

RUN NUMBER: 1	SCHEMATIC OF STACK CROSS SECTION	EQUATIONS	AMBIENT TEMP: 70 °F
DATE: 19 APR 89		$^{o}R = ^{o}F + 460$	STATION PRESS: 28.73 in Hg
PLANT: bld 672		$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$	HEATER BOX TEMP: 250 °F
BASE: Norton		pitot tube check - good	PROBE HEATER SETTING: 250
SAMPLE BOX NUMBER: Nutech 2		pre-leak check @ 15" Hg - good	PROBE LENGTH: 48 in
METER BOX NUMBER: Nutech 2		post leak check @ 9" Hg - good.	NOZZLE ~~AREA (A)~~ diameter .499" ~~sq ft~~
Qw/Qm			Cp: .84
Co		ΔH@ = 1.91	DRY GAS FRACTION (Fd)



TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
Start Time 1316 A 1	0	4.0	260		.06	3.02	388.348	99		98	246	93
2	2.5	4.0	303		.06	2.84		98		97	240	76
3	5.0	4.3	374		.07	3.03		98		97	241	75
4	7.5	4.3	392		.07	2.98		101		98	242	80
5	10.0	5.0	404		.08	3.37		103		99	243	91
6	12.5	5.0	412		.08	3.35		107		99	245	103
7	15.0	5.0	418		.08	3.33		109		100	245	110
8	17.5	5.5	423		.085	3.53		111		101	247	116
9	20.0	5.5	423		.085	3.54	408.518	114		102	248	120
10	22.5	5.0	410		.06	2.54	408.518	114		102	247	123
11	25.0	4.2	417		.065	2.73		112		103	247	166
BT 12	27.5	4.2	420		.065	2.72		114		104	249	166
	30.0 (STOP)						416.419					

Total ft³ = 56.554

Boiler shut down momentarily @ pt 9

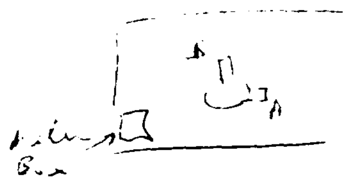
OEHL FORM MAY 78 18

PARTICULATE SAMPLING DATA SHEET

Trans. of two

RUN NUMBER	1
DATE	19 APR 89
PLANT	bld 612
BASE	Norton
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = ^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

See pg 1

AMBIENT TEMP	70 °F
STATION PRESS	28.73 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	210
PROBE LENGTH	48 in
NOZZLE ~~AREA (A)~~ diameter	.499" ~~sq ft~~
Cp	.84
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
Start 1	0	4.1	250		.05	2.60	416.420	112		106	245	113
2	2.5	4.1	376		.06	2.74		110		105	244	89
3	5.0	4.2	379		.065	2.86		114		107	245	92
4	7.5	4.2	404		.065	2.78		115		107	245	94
5	10.0	4.2	413		.065	2.96		118		108	245	98
6	11.5	4.5	420		.07	2.96		119		108	247	101
7	15.0	4.5	422		.075	3.16		119		108	246	103
8	17.5	5.0	422		.08	3.38		120		109	246	105
9	20.0	5.0	421		.08	3.38		120		110	245	105
10	22.5	5.0	420		.075	3.18		120		110	247	106
11	25.0	5.0	421		.075	3.18		121		111	247	106
12	27.5	5.0	423		.075	3.17		121		111	247	106
	30.0 (stop)						444.904					

$\overline{T_s} = 392$

$\overline{\Delta H} = 3.05$

$\sqrt{PSTS} = 7.7461$

$\overline{Tm} = 108$

108

OEHL FORM MAY 78 18

RUN #

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Norton	19 April 89	1

BUILDING NUMBER	SOURCE NUMBER
BLDG 672	HOT WATER BOILER GAS-FIRED

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2890	0.2885	0.0005
ACETONE WASHINGS *(Probe, Front Half Filter)*	97.8320	97.8216	0.0104
BACK HALF *(If needed)*	Ø	Ø	Ø
	Total Weight of Particulates Collected		.0109 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	234	200	34
IMPINGER 2 *(H20)*	250	200	50
IMPINGER 3 *(Dry)*	9	0	9
IMPINGER 4 *(Silica Gel)*	221.9	200	21.9
	Total Weight of Water Collected		114.9 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	4.2	4.4	4.2		4.3
VOL % O_2	13.6	13.8	13.8		13.7
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE.

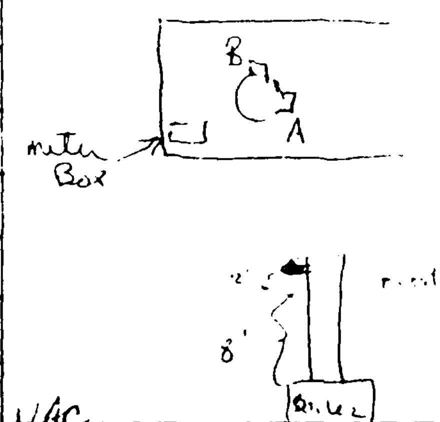
Weather 4380 1 of 2

NAT-GAS - FIRED $\Delta H_@ = 1.91$

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER	2
DATE	20 APR 89
PLANT	bld 672
BASE	Norton AFB
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = {^{o}F} + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

pitot line check - good
preleak check @ 15" Hg - good
postleak check @ 9" Hg - good

AMBIENT TEMP	90 °F
STATION PRESS	~~27.73~~ 28.73 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	48 in
NOZZLE ~~AREA (A)~~ diameter	.499"
Cp	.84
DRY GAS FRACTION (Fd)	

Start time	TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1230	B 1	0	6.0	250		.05	2.32	446.010	96		95	239	95
	2	2.5	6.0	290		.05	2.20		97		95	242	87
	3	5.0	6.5	325		.055	2.32		99		96	245	86
	4	7.5	7.0	400		.06	2.31		100		96	245	85
	5	10.0	7.5	410		.065	2.48		102		97	245	94
	6	12.5	8.0	414		.065	2.47		104		97	246	94
	7	15.0	8.0	418		.07	2.66		107		99	246	96
	8	17.5	8.5	417		.07	2.47		108		100	247	98
	9	20.0	8.5	416		.07	2.48		110		101	247	100
	10	22.5	8.5	415		.07	2.68		110		101	246	104
	11	25.0	8.5	414		.075	2.78		110		102	246	106
1300	12	27.5	9.0	416		.075	2.88		111		103	248	108
		30.0 (good)						472.076					

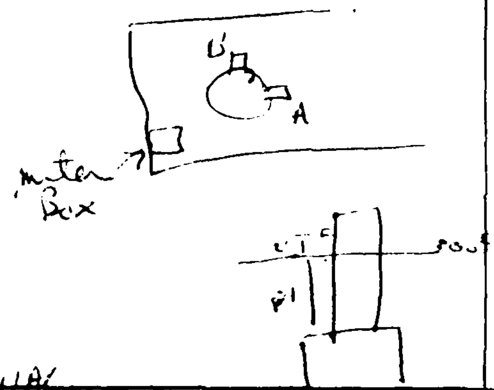
Total ft³ = ~~52.919~~ 52.933

OEHL FORM MAY 78 18

PARTICULATE SAMPLING DATA SHEET

2 . + 2

RUN NUMBER: 2	SCHEMATIC OF STACK CROSS SECTION	EQUATIONS	AMBIENT TEMP: 90 °F
DATE: 20 APR 89		$^{o}R = {^{o}F} + 460$	STATION PRESS: 28.73 in Hg
PLANT: Bld 672		$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$	HEATER BOX TEMP: 250 °F
BASE: Norton AFB			PROBE HEATER SETTING: 250
SAMPLE BOX NUMBER: Nutech 2		See pg).	PROBE LENGTH: 48 in
METER BOX NUMBER: Nutech 2			NOZZLE AREA (A): sq ft
Qw/Qm			Cp: .84
Co			DRY GAS FRACTION (Fd)



Start time

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	VAC STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1323 A 1	0	7.0	240		.055	2.64 ~~2.05~~	472.090	107		105	243	101
2	2.5	8.0	310		.065	2.83		106		105	246	81
3	5.0	9.0	350		.07	2.90		106		104	244	80
4	7.5	7.5	380		.06	2.37		107		105	245	84
5	10.0	8.5	405		.07	2.72		108		105	247	90
6	12.5	8.0	411		.065	2.51		109		105	246	92
7	15.0	8.0	415		.07	2.69		110		105	247	97
8	17.5	8.5	418		.07	2.69		112		106	248	101
9	20.0	8.5	419		.07	2.69		113		106	248	104
10	22.5	8.5	420		.07	2.69		113		105	248	108
11	25.0	8.5	420		.07	2.69		114		107	247	108
1353 12	27.5	8.5	420		.67	2.69		115		107	248	110
	30.0						498.953					
									105			
			$\bar{T}_s$: 401		ΔH	2.01						
					$\sqrt{\Delta P}$ =	7.4475						
					$\bar{T}m$: 105							

OEHL FORM MAY 78 18

RUN 2 (?)

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	20 APR 89	2

BUILDING NUMBER	SOURCE NUMBER
BLDG 672	BOILER HOT WATER GAS-FIRED

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.2898	0.2898	Ø
ACETONE WASHINGS (*Probe, Front Half Filter*)	110.5405	110.5338	0.0067
BACK HALF (*If needed*)	Ø	Ø	Ø
	Total Weight of Particulates Collected		0.0067 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 (*H20*)	223	200	23
IMPINGER 2 (*H20*)	247	200	47
IMPINGER 3 (*Dry*)	19.4	0	19.4
IMPINGER 4 (*Silica Gel*)	230.7	200	30.7
	Total Weight of Water Collected		120.1 gm

III. GASES (*Dry*)

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	7.0	7.0	7.0		7.0
VOL % O_2	8.6	8.6	8.6		8.6
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE

NAT. GAS-FIRED DH@ = 1.91

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 3

DATE: 20 APR 89

PLANT: Bld 672

BASE: Norton

SAMPLE BOX NUMBER: Nutech 2

METER BOX NUMBER: Nutech 2

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION

B C A

EQUATIONS

$^{o}R = {}^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

pitot tube check - good

preleak check @ 15" Hg - good

post leak check @ 15" Hg - good

AMBIENT TEMP: 90 °F

STATION PRESS: 28.73 in Hg

HEATER BOX TEMP: 250 °F

PROBE HEATER SETTING: 250

PROBE LENGTH: 48 in

NOZZLE ~~AREA (A)~~ diameter: .499" ~~sq ft~~

Cp: .84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	0	5.5	250		.05	2.37	499.631	108		107	230	88
2	2.5	5.5	310		.06	2.62		107		107	233	71
3	5.0	6.5	365		.065	2.65		107		107	238	61
4	7.5	6.0	380		.055	2.21		109		107	240	64
5	10.0	6.0	400		.06	2.36		112		108	242	68
6	12.5	6.0	408		.06	2.33		112		107	242	68
7	15.0	6.0	413		.06	2.32		112		107	243	68
8	17.5	6.0	419		.06	2.31		114		107	245	69
9	20.0	6.0	420		.065	2.50		115		108	245	70
10	22.5	6.5	424		.065	2.50		115		109	247	71
11	25.0	6.5	424		.065	2.51		117		109	248	71
12	27.5	6.5	424		.065	2.51		118		110	248	70
	30.0 (stop)						525.386					

St. Time 1434

1004

OEHL FORM MAY 78 18

PARTICULATE SAMPLING DATA SHEET

2 of 2

RUN NUMBER	3
DATE	20 Apr 89
PLANT	Bld 672
BASE	Norton AFB
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION

Sec 1

Vert

EQUATIONS

$^{o}R = {}^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

Sec 1.

AMBIENT TEMP	90 °F
STATION PRESS	28.73 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	48 in
NOZZLE ~~AREA~~ (A) d.	.457" ~~sq ft~~
Cp	.84
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	0	5.5	240		.05	2.42	525.286	112		111	242	90
2	2.5	6.0	240		.055	2.33		114		111	245	66
3	5.0	5.5	385		.055	2.21		115		112	246	61
4	7.5	5.0	404		.05	1.97		116		112	245	62
5	10.0	5.0	413		.05	1.97		117		113	246	66
6	12.5	5.0	416		.06	2.33		117		112	246	66
7	15.0	5.5	418		.065	2.52		117		112	246	66
8	17.5	6.0	420		.07	2.71		117		112	246	66
9	20.0	7.0	418		.07	2.72		118		112	246	66
10	22.5	7.0	417		.07	2.72		117		112	246	67
11	25.0	7.0	415		.07	2.73		118		112	246	62
12	27.5	7.0	415		.07	2.73		118		112	246	62
	30.0 (stop)						551.014					
									112			
		$\overline{T_s}$ =	389									
		$\overline{\Delta H}$ =	2.44			Total	Ft³ =	51.383				
		$\overline{\sqrt{P_{STS}}}$ =	7.1904									
		$\overline{T_m}$ = 112										

St. Time

41

OEHL FORM 18 MAY 78

RUN 3

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	20 APR 89	3

BUILDING NUMBER	SOURCE NUMBER
BLDG 762	BOILER HOT WATER GAS FIRED

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.2897	0.2896	0.0001
ACETONE WASHINGS *(Probe, Front Half Filter)*	100.1160	100.1093	0.0067
BACK HALF *(If needed)*	∅	∅	∅
	Total Weight of Particulates Collected		0.0068 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER * (gm)
IMPINGER 1 *(H20)*	214	200	14
IMPINGER 2 *(H20)*	310	200	110
IMPINGER 3 *(Dry)*	2	0	2
IMPINGER 4 *(Silica Gel)*	213.6	200	13.6
	Total Weight of Water Collected		139.6 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	7.0	7.0	7.0		7.0
VOL % O_2	9.0	9.0	9.0		9.0
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 19 APR 89

Sample location BLD 672 RUN 1

Barometric pressure, mm (in.) Hg 28.73

Ambient temperature, ~~°C~~ (°F) 70 Stack temperature, ~~°C~~ (°F) 392

Intital leak check good Final leak check good

Operator Lt Ali

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		4.3	
2	1.0			
3	1.0			
4	1.0			
5	1.1			
6	1.1			
7	1.1			
8	1.1			
9	1.1			
10	0.9			
11	1.0			
12	1.0			
13	1.0			
14	1.0			
15	1.0			
16	1.0			
17	1.0			
18	1.0			
19	1.0			
20	1.1			
21	1.1			
22	1.0			
23	1.0			
24	1.0			

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 20 APR 89

Sample location BLD 672 RUN 2

Barometric pressure, mm (in.) Hg 28.73

Ambient temperature, ~~°C~~ (°F) 90 Stack temperature, ~~°C~~ (°F) 401

Intital leak check good Final leak check good

Operator Lt Ml

TRAVERSE ~~Clock time,~~ 24 h POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		7.0	
2	1.0			
3	1.0			
4	1.0			
5	1.0			
6	1.0			
7	1.1			
8	1.1			
9	1.1			
10	1.1			
11	1.2			
12	1.2			
13	1.1			
14	1.2			
15	1.2			
16	1.0			
17	1.1			
18	1.1			
19	1.1			
20	1.1			
21	1.1			
22	1.1			
23	1.1			
24	1.1			

Quality Assurance Handbook M10-4.2

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 20 APR 89

Sample location BLD 672 RUN 3

Barometric pressure, mm (in.) Hg 28.73

Ambient temperature, ~~°C~~ (°F) 90 Stack temperature, ~~°C~~ (°F) 389

Intital leak check good Final leak check good

Operator Lt ALI

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		7.0	
2	1.1			
3	1.1			
4	1.0			
5	1.0			
6	1.0			
7	1.0			
8	1.0			
9	1.1			
10	1.1			
11	1.1			
12	1.1			
13	1.0			
14	1.0			
15	1.0			
16	0.9			
17	0.9			
18	1.0			
19	1.1			
20	1.2			
21	1.2			
22	1.2			
23	1.2			
24	1.2			

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Heating Plant City

Sample location Bldg 672 Date 17 APR 87

Operator Capt Vaughn Barometric pressure (P_{bar}) 28.73 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_f), ml	Initial pressure mm ~~in.~~ Hg			Initial temperature	
						Leg A_i	Leg B_i	P_i[a]	°F (t_i)	°R (T_i)[b]
1-1	Port B	1200	~~162~~ 360	T	2085					
1-1	Port B	1315	335	1	2085			62	105	
1-2	Port B	1335	185	2	2054			72	105	
1-3	Port A	1405	184	3	2075			70	117	
1-4	Port A	1420	238	4	2070			60	115	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

1-1

Run # Sample #

NO_x Sample Recovery and Integrity Data Form
(English units)

Plant [illegible] AFB Heating Plant Date 20 Aug. 84 Bldg 672

Sample recovery personnel Capt Vaughn Barometric pressure, (P_{bar}) ______ in. Hg

Person with direct responsibility for recovered samples Capt Vaughn

Sample number	Final Pressure, mm ~~in.~~ Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_f	Leg B_f	P_f[a]	°C ~~°F~~ (t_f)	°R (T_f)[b]				
1-1			682	22		0815	10	✓	
1-2			718	22		0845	10	✓	
1-3			711	22		0900	10	✓	
1-4			682	22		0915	10	✓	

[a] $P_f = P_{bar} - (A_f + B_f)$.

[b] $T_f = t_f + 460°F$.

Lab person with direct responsibility for recovered samples ______

Date recovered samples received ______ Analyst ______

All samples identifiable? ______ All liquids at marked level? ______

Remarks ______

Signature of lab sample trustee ______

1-1

Run # ↑ ← sample #

Run #2

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Bldg 672

Sample location 1

Operator

City

Date 20 Apr 88

Barometric pressure (P_{bar}) 28.73 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_F), ml	Initial pressure ~~in~~ mm Hg			Initial temperature	
						Leg A,	Leg B,	P_i[a]	°F (t_i)	°R (T_i)[b]
2-1	A	1215	121	5	2090			62	117	
2-2	A	1255	145	6	2072			65	117	
2-3	B	1330	122	7	2066			64	115	
2-4	B	1350	119	8	2070			61	112	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

2-1
Run # Sample #

Quality Assurance Handbook M7.4.1A

NO$_x$ Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Bldg 672 Date 21 Apr 87

Sample recovery personnel Capt Vaughn Barometric pressure, (P_{bar}) ______ in. Hg

Person with direct responsibility for recovered samples ______

Sample number	Final Pressure, mm ~~in.~~ Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_f	Leg B_f	P_f[a]	°C ~~°F~~ (t_f)	°R (T_f)[b]				
2-1			677	21		0730	10	✓	
2-2			685	22		0745	10	✓	
2-3			682	22		0755	10	✓	
2-4			689	22		1005	10	✓	

[a] $P_f = P_{bar} - (A_f + B_f)$.

[b] $T_f = t_f + 460°F$.

Lab person with direct responsibility for recovered samples ______

Date recovered samples received ______ Analyst ______

All samples identifiable? ______ All liquids at marked level? ______

Remarks ______

Signature of lab sample trustee ______

Run #3

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Bldg 672 **City** ______

Sample location ______ **Date** 20 Ap. 87

Operator ______ **Barometric pressure (P_{bar})** 28.73 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_f), ml	Initial pressure mm in Hg			Initial temperature	
						Leg A_i	Leg B_i	P_i[a]	°F (t_i)	°R (T_i)[b]
3-1	Port B	1440	120	7	2087			57	107	
3-2	Port B	1455	240	10	2080			72	111	
3-3	Port A	1520	210	11	2084			71	116	
3-4	Port A	1535	220	12	2072			72	118	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

NO_x Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Bldg 673 Date 21 Apr 89

Sample recovery personnel [illegible] Barometric pressure, (P_{bar}) ______ in. Hg

Person with direct responsibility for recovered samples ______

Sample number	Final Pressure, mm ~~in.~~ Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_i	Leg B_i	P_i[a]	°C ~~°F~~ (t_i)	°R (T_i)[b]				
3-1			678	22		1020	10	✓	
3-2			680	23		1030			
3-3			680	23		1040	10	✓	
3-4			674	23		1050	10	✓	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

Lab person with direct responsibility for recovered samples ______

Date recovered samples received ______ Analyst ______

All samples identifiable? ______ All liquids at marked level? ______

Remarks ______

Signature of lab sample trustee ______

Quality Assurance Handbook M7-4.2A

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APPENDIX D

BUILDING 249 BOILER 1 FIELD DATA

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DETERMINATION OF MINIMUM NUMBER OF TRAVERSE POINTS

Stack ID: Bld 249 #1 Stack diameter at ports: 1.58 (ft)

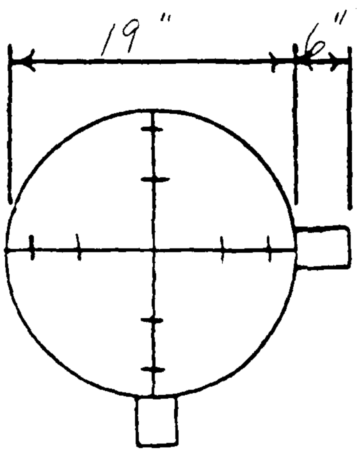
Distance A (ft) 9'4" (duct diameters) 5.9

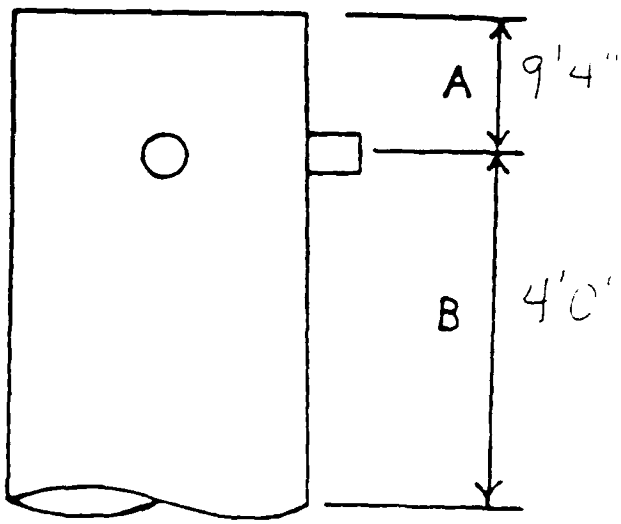
Recommended number of traverse points as determined by distance A: 12

Distance B (ft) 4' (duct diameters) 2.5

Recommended number of traverse points as determined by distance B: 24

Number of traverse points used: 24



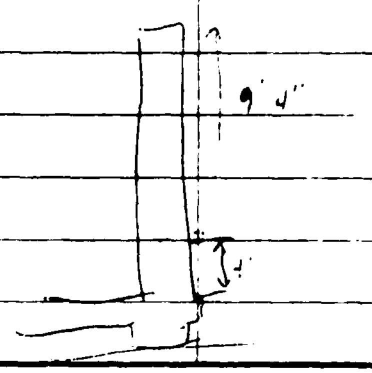


PRELIMINARY SURVEY DATA SHEET NO. 1
(Stack Geometry)

ASE Norton AFB	PLANT Bld #249
ATE 24 APR 89	SAMPLING TEAM
OURCE TYPE AND MAKE Boiler	
OURCE NUMBER	INSIDE STACK DIAMETER 19" Inches
ELATED CAPACITY	TYPE FUEL NAT. GAS
ISTANCE FROM OUTSIDE OF NIPPLE TO INSIDE DIAMETER 6" Inches	
UMBER OF TRAVERSES 2	NUMBER OF POINTS/TRAVERSE 12

LOCATION OF SAMPLING POINTS ALONG TRAVERSE

POINT	PERCENT OF DIAMETER	DISTANCE FROM INSIDE WALL *(Inches)*	TOTAL DISTANCE FROM OUTSIDE OF NIPPLE TO SAMPLING POINT *(Inches)*
1			6.5
2			7.3
3			8.2
4			9.4
5			10.8
6			12.8
7			18.2
8			20.3
9			21.6
10			22.8
11			23.7
12			24.5



OEHL FORM APR 78 15

PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE	DATE
Norton	24 APR 89

BOILER NUMBER: bld 249

INSIDE STACK DIAMETER: 19 Inches

STATION PRESSURE: 28.705 In Hg

STACK STATIC PRESSURE: 0.05 In H20

SAMPLING TEAM:

TRAVERSE POINT NUMBER	VELOCITY HEAD, Vp IN H20	α		STACK TEMPERATURE (°F)
1	.12	10	12	170
2	.13	5	12	270
3	.13	8	10	380
4	.13	8	8	390
5	.12	3	5	395
6	.10	0	3	397
7	.09	4	0	399
8	.11	0	0	400
9	.13	10	3	401
10	.14	0	5	402
11	.16	11	5	402
12	.16	5	3	402
	STACK	HOH = .05		
	FPS =	29		
	$\overline{\Delta p}$ =	.13		
	$\overline{T_s}$ =	367		
	Nozzel =	.3767		
	WK =			
AVERAGE				

OEHL FORM APR 78 16

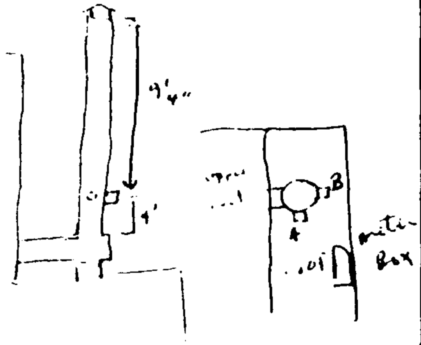
NAT GAS FIRED

$\Delta H_@ = 1.91$

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER	1
DATE	24 April 89
PLANT	bld 249
BASE	Norton
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$°R = °F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

pitot tube check – good

preleak check @ 15" Hg = good

postleak check @ 20" Hg = good

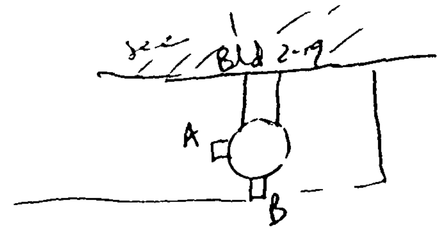
AMBIENT TEMP	75 °F
STATION PRESS	28.705 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	48 in
NOZZLE ~~AREA (A)~~ diam	.3767 (.375) ~~sq ft~~
Cp	.84
DRY GAS FRACTION (Fd)	

	TRAVERSE POINT NUMBER	SAMPLING TIME (min)	UAC STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
Start 1057	1	A 0	3.0	264		.12	1.67	551.439	73		73	244	71
	2	2.5	3.0	288		.15	2.02		74		72	244	58
	3	5.0	3.0	266		~~.20~~ .15	2.08		75		71	255	52
	4	7.5	2.5	375		.13	1.57		77		72	252	54
	5	10.0	2.5	406		.12	1.40		79		72	232	57
	6	12.5	2.0	408		.11	1.28		79		72	232	58
	7	15.0	2.0	409		.10	1.17		79		72	243	61
	8	17.5	2.0	408		.11	1.28		79		72	242	62
	9	20.0	2.0	407		.14	1.64		80		73	257	64
	10	22.5	2.5	403		.16	1.87		81		73	244	66
	11	25.0	3.0	405		.17	1.99		82		73	244	67
1127	12	27.5	3.0	408		.16	1.88		83		74	246	70
		30.0 (end)						572.358					

OEHL FORM 18 MAY 78

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER	SCHEMATIC OF STACK CROSS SECTION	EQUATIONS	AMBIENT TEMP
1			75 °F
DATE: 24 Apr 89			STATION PRESS: 28.705 in Hg
PLANT: Bldg 249			HEATER BOX TEMP: 250 °F
BASE: Norton			PROBE HEATER SETTING: 250
SAMPLE BOX NUMBER: Nutech 2			PROBE LENGTH: 48 in
METER BOX NUMBER: Nutech 2			NOZZLE ~~AREA~~ diam: .3767 (.375")
Qw/Qm			Cp: .84
Co			DRY GAS FRACTION (Fd)



EQUATIONS

$^{\circ}R = ^{\circ}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

see 1

65 Start

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1132 1	B 0	3.0	230		.15	2.20	572.358	77		74	240	75
2	2.5	4.0	225		.20	2.96		77		74	242	67
3	5.0	4.0	292		.20	2.71		82		75	244	63
4	7.5	4.0	396		.19	2.27		85		76	244	62
5	10	3.5	411		.16	1.88		86		76	246	64
6	12.5	3.0	413		.14	1.64		87		76	246	65
7	15.0	2.0	412		.085	1.00		88		77	247	67
8	17.5	2.0	408		.09	1.07		89		78	247	68
9	20	2.0	406		.085	1.01		89		79	246	69
10	22.5	2.0	400		.085	1.01		89		79	246	67
11	25.0	2.0	404		.085	1.01		89		79	246	67
12	27.5	2.0	403		.085	1.01		89		79	246	66
1202	30.0 (stop)						592.790					
			$\overline{T_s}$ = 369						78			
			$\overline{\Delta H}$ = 1.65			total ft³ = 41.351						
			$\sqrt{PSTS}$ =		10.3360							

OEHL FORM MAY 78 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	24 MAR 89	1

BUILDING NUMBER	SOURCE NUMBER
249	BOILER #1, GAS FIRED

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.2944	0.2944	Ø
ACETONE WASHINGS *(Probe, Front Half Filter)*	104.8893	104.8834	0.0059
BACK HALF *(If needed)*	Ø	Ø	Ø
	Total Weight of Particulates Collected		0.0059 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	235	200	35
IMPINGER 2 *(H20)*	241	200	41
IMPINGER 3 *(Dry)*	10	0	10
IMPINGER 4 *(Silica Gel)*	214.6	200	14.6
	Total Weight of Water Collected		100.6 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	6.0	6.0	6.0		6.0
VOL % O_2	9.8	9.8	9.8		9.8
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM MAY 78 20

NAT.GAS-FIRED

PARTICULATE SAMPLING DATA SHEET

1 of 2

RUN NUMBER: 2

DATE: 24 Apr 87

PLANT: Bld 249

BASE: Norton

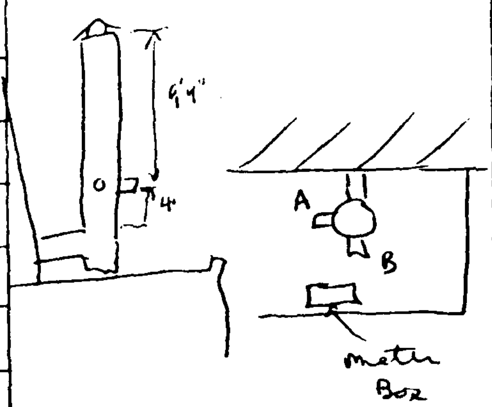
SAMPLE BOX NUMBER: Nutech 2

METER BOX NUMBER: Nutech 2

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = {}^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

pitot tube check - good.

Preleak check @15" Hg = good.

post leak check @14" Hg - good.

AMBIENT TEMP: 75 °F

STATION PRESS: 28.705 in Hg

HEATER BOX TEMP: 250 °F

PROBE HEATER SETTING: 250

PROBE LENGTH: 48 in

NOZZLE ~~AREA (A)~~ diam.: .375"

Cp: .84

DRY GAS FRACTION (Fd):

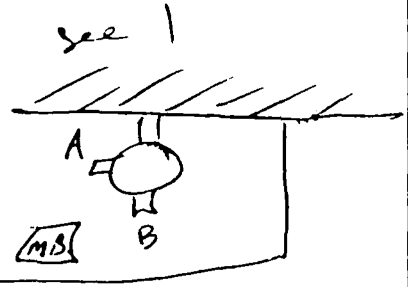
	TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) UAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
START 1244	1	B 0	2.0	230		.15	2.22	593.423	79		79	230	68
	2	2.5	5.0	250		.19	2.73		80		80	233	57
	3	5.0	4.5	345		.19	2.41		82		80	236	55
	4	7.5	4.5	394		.19	2.28		85		80	236	56
	5	10.0	4.5	405		.17	2.02		88		81	239	59
	6	12.5	3.5	411		.135	1.60		90		82	240	63
	7	15.0	2.5	412		.08	0.95		92		83	240	68
	8	17.5	2.5	408		.08	0.96		92		84	240	73
	9	20.0	2.5	404		.08	0.96		92		84	240	74
	10	22.5	2.5	403		.08	0.96		91		84	240	77
	11	25.0	2.5	402		.08	0.96		91		84	241	79
	12	27.5	2.5	401		.08	0.96		91		84	241	81
1317		30.0 (633)						613.473					

OEHL FORM MAY 78 18

PARTICULATE SAMPLING DATA SHEET

2 of 2

RUN NUMBER: 2	SCHEMATIC OF STACK CROSS SECTION	EQUATIONS	AMBIENT TEMP: 75 °F
DATE: 24 Apr 89	see 1	$^{o}R = {^{o}F} + 460$	STATION PRESS: 28.705 in Hg
PLANT: bld 249		$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$	HEATER BOX TEMP: 250 °F
BASE: Norton		see 1	PROBE HEATER SETTING: 250
SAMPLE BOX NUMBER: Nutech 2			PROBE LENGTH: 48 in
METER BOX NUMBER: Nutech 2			NOZZLE ~~AREA (A)~~ diam.: .375" ~~sq ft~~
Qw/Qm			Cp: .84
Co			DRY GAS FRACTION (Fd)



	TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
START 1322	1	A 0	3.5	253		.16	1.59	613.473	87		86	242	78
	2	2.5	3.5	303		.13	1.76		87		86	243	74
	3	5.0	4.0	375		.14	1.74		91		86	243	74
	4	7.5	3.5	397		.13	1.58		92		86	243	76
	5	10.0	3.5	407		.125	1.50		92		86	242	78
	6	12.5	3.0	407		.095	1.14		93		87	243	82
	7	15.0	2.5	407		.09	1.08		93		87	243	86
	8	17.5	3.5	405		.12	1.44		93		87	243	87
	9	20.0	3.5	406		.14	1.68		93		87	243	87
	10	22.5	4.0	407		.16	1.92		93		87	243	89
	11	25.0	4.0	407		.17	2.04		94		87	242	92
1352	12	27.5	4.0	405		.16	1.93		94		87	243	94
		30.0 (stop)						634.015					
				$\overline{Ts} = 377$						87			
				$\overline{\Delta H} = 1.60$			total ft³ = 40.592						
				$\overline{\sqrt{\Delta P}} = 10.2150$									

OEHL FORM MAY 78 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	24 APR 89	2

BUILDING NUMBER	SOURCE NUMBER
249	BOILER #1, GAS-FIRED

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.2889	0.2885	0.0004
ACETONE WASHINGS *(Probe, Front Half Filter)*	95.0703	95.0667	0.0036
BACK HALF *(If needed)*	Ø	Ø	Ø
	Total Weight of Particulates Collected		0.0040 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	252	200	52
IMPINGER 2 *(H20)*	243	200	43
IMPINGER 3 *(Dry)*	10	0	10
IMPINGER 4 *(Silica Gel)*	223.6	200	23.6
	Total Weight of Water Collected		128.6 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	5.2	5.2	5.2		5.2
VOL % O_2	10.6	10.6	10.6		10.6
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM MAY 78 20

NAT. GAS - FIRED

PARTICULATE SAMPLING DATA SHEET

1 of 2

RUN NUMBER: 3

DATE: 24 APR 89

PLANT: bld 249

BASE: Norton

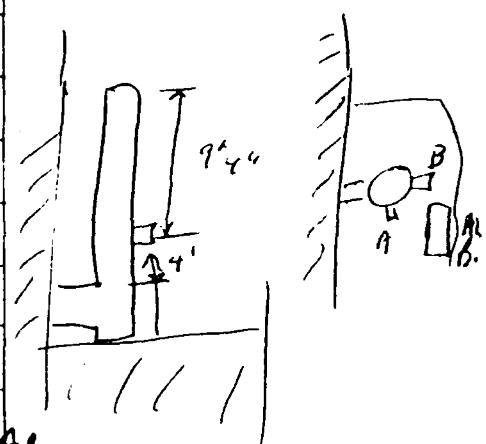
SAMPLE BOX NUMBER: Nutech 2

METER BOX NUMBER: Nutech 2

Qw/Qm

Co

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = ^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

pitot tube check - good.

preleak check @ 15" Hg - good

post leak check @ 11" Hg - good.

AMBIENT TEMP: 75 °F

STATION PRESS: 28.705 in Hg

HEATER BOX TEMP: 250 °F

PROBE HEATER SETTING: 250

PROBE LENGTH: 48 in

NOZZLE ~~AREA (A)~~ diam.: .375" ~~sq ft~~

Cp: .34

DRY GAS FRACTION (Fd)

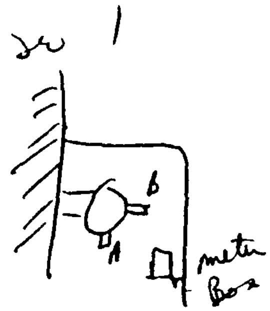
	TRAVERSE POINT NUMBER	SAMPLING TIME (min)	VAC ~~STATIC PRESSURE (in H2O)~~	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
start 1309	1	A 0	4.5	231		.12	1.79	636.144	86		87	233	76
	2	2.5	6.0	280		.13	1.82		86		87	226	72
	3	5.0	8.0	350		.14	1.79		89		86	231	66
	4	7.5	8.5	395		.135	1.64		91		87	234	68
	5	10.0	8.0	405		.12	1.44		91		87	234	71
	6	12.5	6.5	406		.10	1.20		91		86	237	72
	7	15.0	6.5	406		.10	1.20		91		85	235	73
	8	17.5	8.0	404		.12	1.44		90		86	238	73
	9	20.0	9.5	404		.15	1.80		89		85	239	74
	10	22.5	10.0	404		.16	1.91		89		84	237	77
	11	25.0	11.0	406		.17	2.03		89		84	238	79
	12	27.5	11.0	405		.17	2.03		90		84	240	85
1539		30.0 (stop)						658.187					
								ft³ = 22.043					

OEHL FORM MAY 78 18

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER	3
DATE	24 APR 89
PLANT	Bld 249
BASE	Norton
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = {^{o}F} + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

see 1

AMBIENT TEMP	75 °F
STATION PRESS	28.705 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	48 in
NOZZLE ~~AREA (A)~~ diam.	.375" ~~sq ft~~
Cp	.84
DRY GAS FRACTION (Fd)	

	TRAVERSE POINT NUMBER	SAMPLING TIME (min)	VAC STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
Start 1546	1	B 0	4.5	250		.12	1.74	658.188	85		83	234	81
	2	2.5	4.5	270		.18	2.54		86		83	245	72
	3	5.0	6.0	395		.19	2.29		88		83	242	71
	4	7.5	5.0	404		.17	2.03		89		82	240	72
	5	10.0	5.0	410		.16	1.90		89		82	242	72
	6	12.5	4.5	410		.14	1.66		89		82	242	72
	7	15.0	3.0	409		.09	1.07		89		82	239	72
	8	17.5	3.0	406		.085	1.01		89		82	243	73
	9	20.0	3.0	403		.085	1.02		88		82	241	71
	10	22.5	3.0	402		.085	1.01		87		81	237	68
	11	25.0	3.0	401		.09	1.08		87		81	234	69
	12	27.5	3.0	401		.08	0.95		86		80	238	68
1616		30.0 (stop)											
								678.189					
				$\overline{Ts}$ = 377						86			
								20.001					
				$\overline{\Delta H}$ = 1.60									
				$\sqrt{\Delta P s T s}$ = 10.2806			Total ft³ = 42.044						

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	24 APR 89	3

BUILDING NUMBER	SOURCE NUMBER
249	BOILER #1, GAS-FIRED

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	0.2898	0.2894	0.0004
ACETONE WASHINGS *(Probe, Front Half Filter)*	97.0768	97.0732	0.0036
BACK HALF *(If needed)*	Ø	Ø	~~0.0040~~ Ø
	Total Weight of Particulates Collected		0.0040 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	282	200	82
IMPINGER 2 *(H20)*	234	200	34
IMPINGER 3 *(Dry)*	14	0	14
IMPINGER 4 *(Silica Gel)*	219.7	200	19.7
	Total Weight of Water Collected		149.7 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	5.6	5.6	5.6		5.6
VOL % O_2	9.8	9.8	9.8		9.8
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM MAY 78 20

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 24 APR 89

Sample location BLD 249 RUN 1

Barometric pressure, mm (in.) Hg 28.705

Ambient temperature, ~~°C~~ (°F) 75 Stack temperature, ~~°C~~ (°F) 369

Intital leak check good Final leak check good

Operator Lt Ali

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		6.0	
2	1.2			
3	1.2			
4	1.0			
5	1.0			
6	0.9			
7	0.8			
8	0.9			
9	1.0			
10	1.1			
11	1.0			
12	1.1			
13	1.3			
14	1.8			
15	1.7			
16	1.3			
17	1.1			
18	1.0			
19	0.7			
20	0.7			
21	0.7			
22	0.7			
23	0.7			
24	0.7			

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 24 APR 89

Sample location BLD 249 RUN 2

Barometric pressure, mm (in.) Hg 28.705

Ambient temperature, ~~°C~~ (°F) 75 Stack temperature, ~~°K~~ (°F) 377

Intital leak check good Final leak check good

Operator Lt Ali

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.6		5.2	
2	1.2			
3	1.1			
4	1.0			
5	0.9			
6	0.7			
7	0.5			
8	0.5			
9	0.5			
10	0.5			
11	0.5			
12	0.5			
13	0.8			
14	0.9			
15	0.9			
16	0.8			
17	0.8			
18	0.6			
19	0.6			
20	0.8			
21	0.8			
22	0.9			
23	0.9			
24	0.9			

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 24 APR 89

Sample location BLD 249 RUN 3

Barometric pressure, mm (in.) Hg 28.705

Ambient temperature, ~~°C~~ (°F) 75 Stack temperature, ~~°C~~ (°F) 377

Intital leak check good Final leak check good

Operator Lt ALI

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		5.6	
2	1.0			
3	1.0			
4	1.0			
5	0.9			
6	0.8			
7	0.8			
8	0.9			
9	1.0			
10	1.0			
11	1.1			
12	1.1			
13	1.0			
14	1.7			
15	1.3			
16	1.3			
17	1.2			
18	1.0			
19	0.7			
20	0.7			
21	0.7			
22	0.7			
23	0.7			
24	0.7			

Run #1

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB
Sample location Bldg 249
Operator
City
Date 27 Apr-83
Barometric pressure (P_{bar}) 28.705 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_F), ml	Initial pressure ~~in.~~ MM Hg			Initial temperature	
						Leg A_i	Leg B_i	P_i[a]	°F (t_i)	°R (T_i)[b]
1-1	Port B	1055	229	13	2059			55	72	
1-2	Port B	1115	310	14	2080			56	~~69~~ 73	
1-3	Port A	1135	194	15	2082			54	74	
1-4	Port A	1150	194	16	2043			53	75	

[a] $P_i = P_{bar} - (A_i + B_i)$

[b] $T_i = t_i + 460°F$

70

Run # 1

NO_x Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Bldg 247 Date 25 Apr 89

Sample recovery personnel ______ Barometric pressure, (P_{bar}) ______ in. Hg

Person with direct responsibility for recovered samples Capt Vaughn

Sample number	Final Pressure, mm ~~in.~~ Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_i	Leg B_i	P_i[a]	°C ~~°F~~ (t_i)	°R (T_i)[b]				
1-1			707	17		0900	10	✓	
1-2			708	18		0915	10	✓	
1-3			712	18		0925	10	✓	
1-4			715	18		0935	10	✓	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

Lab person with direct responsibility for recovered samples ______

Date recovered samples received ______ Analyst ______

All samples identifiable? ______ All liquids at marked level? ______

Remarks ______

Signature of lab sample trustee ______

Quality Assurance Handbook M7-4 2A

Run # 2

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB
Sample location Bldg 249
Operator

City
Date 24 Apr 89
Barometric pressure (P_{bar}) 28.785 in. Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_F), ml	Initial pressure mm in. Hg			Initial temperature	
						Leg A,	Leg B,	P_i[a]	°F (t_i)	°R (T_i)[b]
2-1	Port A	1250	313	17	2066			58	79	
2-2	Port A	1305	140	18	2074			61	79	
2-3	Port B	1330	301	19	2061			54	83	
2-4	Port B	1345	255	20	2102			61	76	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

Run #2

NO_x Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Date 25 Apr 84

Sample recovery personnel ________ Barometric pressure, (P_{bar}) ________ in. Hg

Person with direct responsibility for recovered samples Capt Vaugh

Sample number	Final Pressure, Mm ~~in.~~ Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_i	Leg B_i	P_i[a]	°C ~~°F~~ (t_i)	°R (T_i)[b]				
2-1			677	18		0950	10	✓	
2-2			694	19		1000	10	✓	
2-3			716	19		1010	10	✓	
2-4			711	20		1020	10	✓	

[a] $P_i = P_{bar} - (A_i + B_i)$

[b] $T_i = t_i + 460°F$.

Lab person with direct responsibility for ecovered samples ________

Date recovered samples received ________ Analyst ________

All samples identifiable? ________ All liquids at marked level? ________

Remarks ________

Signature of lab sample trustee ________

Quality Assurance Handbook M7.4.2A

Run #3

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB City ______

Sample location Bldg 247 Date 24 Apr 83

Operator ______ Barometric pressure (P_{bar}) 28.705 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_f), ml	Initial pressure mm ~~in~~ Hg			Initial temperature	
						Leg A_i	Leg B_i	P_i[a]	°F (t_i)	°R (T_i)[b]
3-1	Port B	1510	184	21	2060			56	90	
3-2	Port B	1525	292	22	2062			58	82	
3-3	Port A	1545	200	23	2086			57	85	
3-4	Port A	1645	110	~~24~~ 27	2066			53	72	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$

Run # 3

NO_x Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Bldg 249 Date 25 Apr 89

Sample recovery personnel ______ Barometric pressure, (P_{bar}) ______ in. Hg

Person with direct responsibility for recovered samples Capt Vaughn

Sample number	Final Pressure, mm Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_t	Leg B_t	P_t[a]	°C ~~°F~~ (t_t)	°R (T_t)[b]				
3-1			696	19		1030	10	✓	
3-2			695	19		1040	10	✓	
3-3			704	19		1050	10	✓	
3-4			716	19		1100	10	✓	

[a] $P_t = P_{bar} - (A_t + B_t)$

[b] $T_t = t_t + 460°F$

Lab person with direct responsibility for recovered samples ______

Date recovered samples received ______ Analyst ______

All samples identifiable? ______ All liquids at marked level? ______

Remarks ______

Signature of lab sample trustee ______

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APPENDIX E

BUILDING 716 BOILER 4

(NATUARL GAS) FIELD DATA

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DETERMINATION OF MINIMUM NUMBER OF TRAVERSE POINTS

Stack ID: Bld 716 #1 Stack diameter at ports: 3.3 (ft)

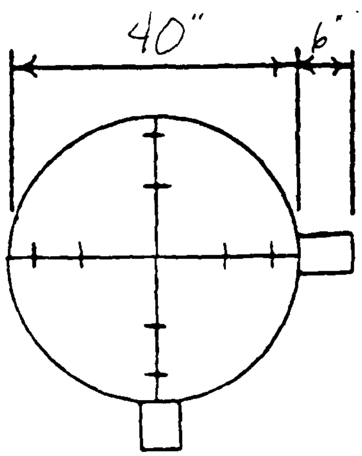
Distance A (ft) 9' (duct diameters) 2.7

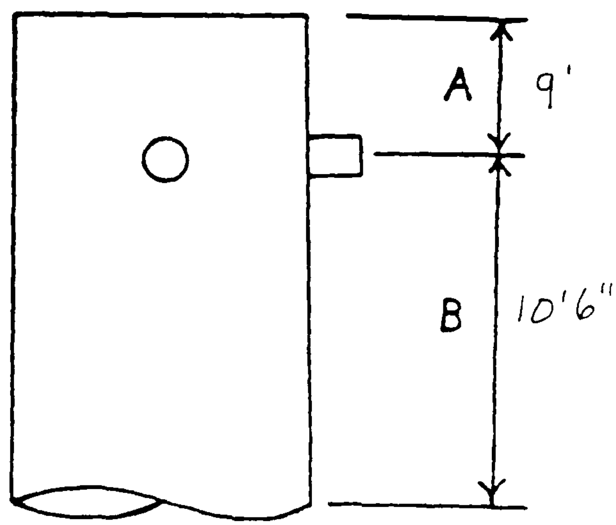
Recommended number of traverse points as determined by distance A: 12

Distance B (ft) 10'6" (duct diameters) 3.15

Recommended number of traverse points as determined by distance B: 24

Number of traverse points used: 24





PRELIMINARY SURVEY DATA SHEET NO. 1
(Stack Geometry)

BASE NORTON	PLANT BLDG 7/6
DATE 27 26 APR 89	SAMPLING TEAM
SOURCE TYPE AND MAKE	
SOURCE NUMBER BOILER # 4	INSIDE STACK DIAMETER 40 Inches
RELATED CAPACITY	TYPE FUEL NAT. GAS (27 APR) / OIL (28 APR)
DISTANCE FROM OUTSIDE OF NIPPLE TO INSIDE DIAMETER 6" Inches	
NUMBER OF TRAVERSES 2	NUMBER OF POINTS/TRAVERSE 12

LOCATION OF SAMPLING POINTS ALONG TRAVERSE

POINT	PERCENT OF DIAMETER	DISTANCE FROM INSIDE WALL *(Inches)*	TOTAL DISTANCE FROM OUTSIDE OF NIPPLE TO SAMPLING POINT *(Inches)*
1			7.0
2			8.7
3			10.7
4			13.1
5			16.0
6			20.2
7			31.8
8			36.0
9			38.9
10			41.3
11			43.3
12			45.0

OEHL FORM APR 78 15

PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE: NORTON	DATE: 26 APR 89 / 27 APR
BOILER NUMBER: BLDG 716, BOILER #4	
INSIDE STACK DIAMETER: 40	Inches
STATION PRESSURE: ~~28.880~~ / 28.865	In Hg
STACK STATIC PRESSURE: 0.045	In H20
SAMPLING TEAM	

TRAVERSE POINT NUMBER	VELOCITY HEAD, V_p IN H20		α ~~[illegible]~~ 27 APR	26 APR			STACK TEMPERATURE (°F)
1	.04	4	11	9	33	-11 +13	~~173~~ 170
2	.055	3	9	13	19	-7 -1	199
3	.065	2	12	22	9	+2 -11	498
4	.07	2	2	16	16	-4 -4	504
5	.07	7	3	9	15	-11 -5	504
6	.07 ~~.065~~	7	8	18	19	-2 -1	503
7	.065	9	3	1	6	-19 -14	502
8	.06	2	3	18	15	-2 -5	501
9	.06	4	3	33	18	+13 -2	501
10	.06	13	2	43	28	+23 +8	502
11	.05	13	9	48	28	+24 +8	502
12	.05	14	12	48	31	+24 +11	501
			good	bad	bad		
		AVG:	6.9	AVG: 21.5			
STATIC ~~H2O~~	.045					-56 -43	-99 +27
						+56 +40	+126 AVE = 21
FPS = 18							
$\overline{\Delta P}$ = .06							
$\overline{T_s}$ = 449			Nozzle = .4999				
			.499 / .499				.501 = $\overline{.500}$
	AVERAGE						

OEHL FORM 16

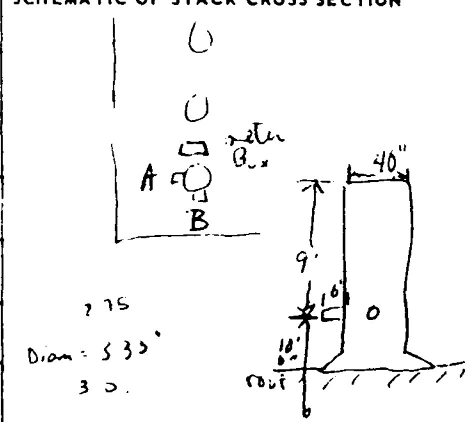
NAT. GAS-FIRED $\Delta H_@ = 1.91$

PARTICULATE SAMPLING DATA SHEET

1 of two

RUN NUMBER	1
DATE	27 ~~26~~ APR 89
PLANT	bld 716 #4
BASE	Norton
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^oR = ^oF + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

pitot tube check - good

pre leak check - good. @ 15" Hg

post leak check - good. @ 15" Hg

AMBIENT TEMP	78 °F
STATION PRESS	~~28.060~~ 28.865 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	72" in
NOZZLE ~~AREA (A)~~ d.	~~.497~~ .500 sq ft
Cp	.84
DRY GAS FRACTION (Fd)	

start 921 — 951

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	A 0	3.0	170		.03	1.49	679.591	65		64	225	57
2	2.5	3.0	180		.03	1.48		68		65	225	43
3	5.0	3.0	395		.04	1.47		67		67	228	45
4	7.5	3.0	433		.035	1.94		66		66	228	42
5	10.0	4.0	490		.06	2.00		70		69	230	43
6	12.5	4.0	504		.06	1.97		72		69	227	42
7	15.0	4.0	510		.075	2.46		73		72	226	43
8	17.5	5.5	516		.08	2.62		78		73	230	44
9	20.0	5.5	513		.09	2.96		77		73	228	43
10	22.5	6.0	513		.10	3.30		78		75	232	44
11	25.0	7.0	518		.10	3.29		80		78	232	47
12	27.5	7.0	519		.10	3.30		82		80	232	49
	30.0 (stop)						703.965					

OEHL FORM 18 MAY 78

PARTICULATE SAMPLING DATA SHEET

2 of 2

RUN NUMBER 1	SCHEMATIC OF STACK CROSS SECTION see 1	EQUATIONS $^{o}R = {}^{o}F + 460$ $H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$ see 1	AMBIENT TEMP 70 °F
DATE 27 ~~26~~ APR 83			STATION PRESS ~~28.80~~ 28.865 in Hg
PLANT bld 716 #4			HEATER BOX TEMP 250 °F
BASE Norton			PROBE HEATER SETTING 250
SAMPLE BOX NUMBER Nutech 2			PROBE LENGTH 72" in
METER BOX NUMBER Nutech 2			NOZZLE ~~AREA (A)~~ d .500 ~~.499~~" ~~sq ft~~
Qw/Qm			Cp .84
Co			DRY GAS FRACTION (Fd)

	TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H_2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
	1	0	4.0	294		.04	1.73	703.765	87		84	235	57
954	2	2.5	5.0	295		.055	2.37		85		85	233	55
	3	5.0	5.0	320		.06	2.52		89		88	236	54
	4	7.5	6.0	490		.08	2.78		94		91	238	56
	5	10.0	6.5	504		.09	3.09		97		92	239	57
	6	12.5	7.0	511		.10	3.42		98		94	240	59
	7	15.0	7.0	516		.10	3.41		100		94	241	59
	8	17.5	7.0	518		.09	3.07		101		94	240	60
	9	20.0	6.0	517		.07	2.39		103		95	243	62
	10	22.5	5.0	515		.06	2.06		103		95	242	64
	11	25.0	4.5	515		.055	1.89		103		96	241	65
1024	12	27.5	4.0	514		.05	1.72		103		96	241	65
		30.0 (stop)						729.385					
										93			

$\overline{\Delta H} = 2.45$

$\overline{T_s} = 449$

$\overline{\sqrt{\Delta P_s}} = 7.8857$

total ft^3 = 49.794

OEHL FORM MAY 78 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	28 APR 89	1

BUILDING NUMBER	SOURCE NUMBER
716	BOILER #4

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2950	.2939	0.0011
ACETONE WASHINGS *(Probe, Front Half Filter)*	97.5492	97.5365	0.0127
BACK HALF *(If needed)*	Ø	Ø	Ø
	Total Weight of Particulates Collected		0.0138 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	340 mls	200	140 mls
IMPINGER 2 *(H20)*	262	200	62 mls
IMPINGER 3 *(Dry)*	2.3 mls	0	2.3 mls
IMPINGER 4 *(Silica Gel)*	204.6	200	4.6
	Total Weight of Water Collected		208.9 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	9.0	9.0	9.0	9.0	9.0
VOL % O_2	4.0	4.2	4.0	N/A	4.0
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

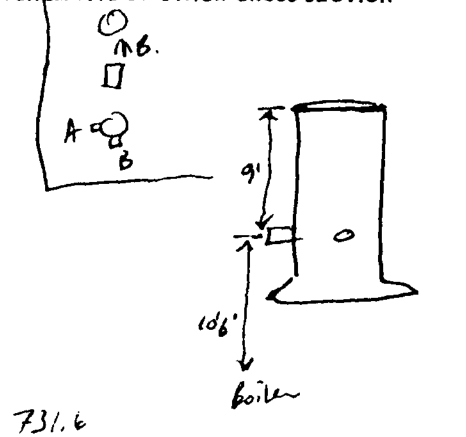
AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE.

NAT GAS - FIRED $\Delta H@ = 1.91$

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER	2
DATE	27 APR 89
PLANT	bld 716 BOILER #4
BASE	Norton
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION



731.6
2.1

EQUATIONS

$^{o}R = {^{o}F} + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

Pitot tube check - good

preleak check @ 15" Hg - good

post leak check @ 7" Hg - good

AMBIENT TEMP	78 °F
STATION PRESS	~~28.880~~ 28.865 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	72" in
NOZZLE ~~AREA (A)~~ d	.499" ~~sq ft~~
Cp	.84
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	0	2.0	85		.04	2.44	729.611	96		96	225	75
2	2.5	2.0	105		.055	3.23		95		95	232	62
3	5.0	2.5	335		.07	2.92		95		95	235	53
4	7.5	2.5	495		.09	3.13		98		95	237	51
5	10.0	2.5	499		.09	3.14		101		96	238	50
6	12.5	3.0	503		.10	3.47		102		96	239	50
7	15.0	2.5	509		.08	2.76		103		96	238	50
8	17.5	2.5	510		.075	2.59		106		96	238	51
9	20.0	2.5	509		.07	2.42		103		96	241	52
10	22.5	2.5	509		.07	2.42		103		96	241	54
11	25.0	2.5	507		.065	2.25		104		97	241	63
12	27.5	2.5	507		.06	2.08		104		97	243	65
	30.0 (stop)						756.907					

start 1052
1122

OEHL FORM MAY 78 18

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER	2
DATE	27 APR 89
PLANT	Bld 716
BASE	Norton
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION

see 1

EQUATIONS

$^{o}R = {}^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

see 1

AMBIENT TEMP	78 °F
STATION PRESS	28.865 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	72" in
NOZZLE ~~AREA (A)~~ d	.499 ~~sq ft~~
Cp	.841
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	VAC ~~STATIC PRESSURE (in H2O)~~	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1128 1	0	2.0	138		.02	1.11	756.907	98		96	239	73
2	2.5	2.6	150		.04	2.19		99		97	240	69
3	5.0	2.5	295		.05	2.21		100		96	240	65
4	7.5	2.5	498		.06	2.09		101		95	239	68
5	10.0	2.5	498		.06	2.09		102		96	240	70
6	12.5	2.5	502		.07	2.43		102		96	241	71
7	15.0	3.5	504		.09	3.12		103		96	241	74
8	17.5	3.5	508		.10	3.46		104		98	242	79
9	20.0	4.0	510		.115	3.98		106		97	243	88
10	22.5	4.0	511		~~.09~~ .11	3.80		106		97	243	94
11	25.0	4.0	510		.10	3.47		108		98	244	102
1158 12	27.5	4.0	509		.09	3.13		108		99		104
	30.0 (stop)						783.392					
									95			
		$\bar{T}_s$ =	404			total ft³ = ~~[illegible]~~ 53.781						
		ΔH =	2.64									
		$\sqrt{BTS}$ =	7.6686									

OEHL FORM 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	28 APR 89	2

BUILDING NUMBER	SOURCE NUMBER
716	BOILER # 4

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2920	.2897	0.0023
ACETONE WASHINGS *(Probe, Front Half Filter)*	94.7822	94.7757	0.0065
BACK HALF *(If needed)*	∅	∅	∅
	Total Weight of Particulates Collected		0.0088 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	300 mls	200	100 mls
IMPINGER 2 *(H20)*	258 mls	200	58 mls
IMPINGER 3 *(Dry)*	18.2 mls	0	18.2 m[illegible]
IMPINGER 4 *(Silica Gel)*	225.8	200	25.8
	Total Weight of Water Collected		202.0 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	7.0	7.0	7.0	N/A	7.0
VOL % O_2	5.8	5.8	5.8	N/A	5.8
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM 20 MAY 78

NAT GAS-FIRED

$\Delta H@ = 1.91$

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 3

DATE: 27 APR 89

PLANT: Bld 716 BOILER #4

BASE: Norton

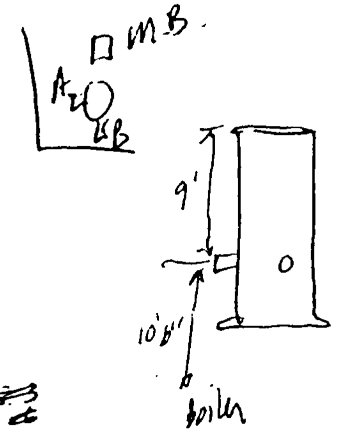
SAMPLE BOX NUMBER: Nutech 2

METER BOX NUMBER: Nutech 2

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$^{o}R = ^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

pitot tube check - good

preleak check @ 15 "Hg - good

post leak check @ 8 "Hg - good

AMBIENT TEMP: 78 °F

STATION PRESS: ~~28.850~~ 28.865 in Hg

HEATER BOX TEMP: 250 °F

PROBE HEATER SETTING: 250

PROBE LENGTH: 72 in

NOZZLE ~~AREA (A)~~ $\varnothing$: .494 sq ft

Cp: .84

DRY GAS FRACTION (Fd):

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	0	2.0	168		.02	1.18	784.103	97		97	225	83
2	2.5	2.0	116		.03	1.74		98		97	225	69
3	5.0	3.0	310		.05	2.16		98		97	225	64
4	7.5	4.0	496		.06	2.10		100		97	224	56
5	10.0	4.0	503		.065	2.25		101		96	235	54
6	12.5	4.5	505		.07	2.43		103		97	234	53
7	15.0	5.0	507		.08	2.77		104		97	238	52
8	17.5	6.5	511		.10	3.45		105		97	239	52
9	20.0	7.5	512		.11	3.80		106		98	238	52
10	22.5	8.0	514		.12	4.15		108		98	240	52
11	25.0	8.0	513		.11	3.81		109		99	241	52
12	27.5	7.5	514		.10	3.47		110		100	242	52
	30.0 (stop)						810.344					

OEHL FORM 18 MAY 78

2 of 2

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER	3
DATE	27 Apr 89
PLANT	old 716
BASE	Norton
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION

See 1

EQUATIONS

$^{o}R = ^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

See 1.

AMBIENT TEMP	78 °F
STATION PRESS	28.865 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	72 in
NOZZLE ~~AREA (A)~~ d	.499" ~~sq ft~~
Cp	.84
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
START 1	0	5.0	225		.05	2.46	810.346	105		101	241	61
2	2.5	6.5	185		.06	3.14		107		101	240	55
3	5.0	6.0	390		.07	2.78		109		101	241	52
4	7.5	6.0	495		.08	2.83		110		101	240	52
5	10.0	6.0	502		.08	2.81		110		101	240	53
6	12.5	6.0	508		.075	2.62		110		101	240	53
7	15.0	6.0	507		.075	2.62		109		102	241	54
8	17.5	5.0	508		.06	2.09		108		101	241	54
9	20.0	5.0	508		.06	2.09		108		101	239	54
10	22.5	5.0	507		.06	2.09		107		100	239	54
11	25.0	5.0	507		.055	1.92		107		100	239	54
12	27.5	4.5	504		.05	1.74		106		99	242	55
	30.0	(stop)					835.869					
									102			

$\overline{Ts} = 436$

$\overline{\Delta H} = 2.60$

$\overline{\sqrt{\Delta P\,Ts}} = 7.8498$

total ft^3 = 51.766

FORM

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	28 APR 89	3

BUILDING NUMBER	SOURCE NUMBER
716	BOILER #4

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2964	.2936	0.0028
ACETONE WASHINGS *(Probe, Front Half Filter)*	96.8854	96.8796	0.0058
BACK HALF *(If needed)*	ϕ	ϕ	ϕ
	Total Weight of Particulates Collected		0.0086 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	364 ml/s	200	164 ml/s
IMPINGER 2 *(H20)*	230 ml/s	200	30 ml
IMPINGER 3 *(Dry)*	3.6 ml/s	0	3.6 ml/s
IMPINGER 4 *(Silica Gel)*	211.8	200	11.8
	Total Weight of Water Collected		209.4 gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	[illegible]	5.2	5.0		5.0
VOL % O_2	[illegible]	3.2	3.0		3.0
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM 20 MAY 78

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 27 APR 89

Sample location BLD 716 RUN 1 (GAS FIRED)

Barometric pressure, mm (in.) Hg 28.865

Ambient temperature, ~~°C~~ (°F) 78 Stack temperature, ~~°C~~ (°F) 449

Intital leak check good Final leak check good

Operator LT ALL

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		9.0	
2	1.0			
3	1.0			
4	1.4			
5	1.5			
6	1.5			
7	1.7			
8	1.8			
9	2.0			
10	2.2			
11	2.2			
12	2.2			
13	1.1			
14	1.7			
15	1.7			
16	1.8			
17	1.9			
18	2.0			
19	2.0			
20	1.9			
21	1.5			
22	1.2			
23	1.1			
24	1.0			

Quality Assurance Handbook M10-4.2

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 27 APR 89

Sample location BLD 716 RUN 2 (GAS FIRED)

Barometric pressure, mm (in.) Hg 28.865

Ambient temperature, ~~°C~~ (°F) 78 Stack temperature, ~~°C~~ (°F) 404

Intital leak check good Final leak check good

Operator LT ALI

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		7.0	
2	1.4			
3	1.3			
4	1.4			
5	1.4			
6	1.5			
7	1.2			
8	1.0			
9	1.0			
10	1.0			
11	0.9			
12	0.9			
13	0.5			
14	0.9			
15	0.9			
16	0.9			
17	1.0			
18	1.4			
19	1.5			
20	1.6			
21	1.6			
22	1.5			
23	1.5			
24	1.3			

Quality Assurance Handbook M10-4.2

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 27 APR 89

Sample location BLD 716 RUN 3 (GAS FIRED)

Barometric pressure, mm (in.) Hg 28.865

Ambient temperature, ~~°C~~ (°F) 78 Stack temperature, ~~°C~~ (°F) 449

Intital leak check good Final leak check good

Operator Lt ALI

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		9.0	
2	1.5			
3	1.9			
4	1.9			
5	2.0			
6	2.1			
7	2.6			
8	3.3			
9	3.7			
10	4.0			
11	3.7			
12	3.3			
13	2.0			
14	3.0			
15	2.6			
16	2.6			
17	2.5			
18	2.5			
19	2.0			
20	2.0			
21	1.9			
22	1.9			
23	1.9			
24	1.9			

Quality Assurance Handbook M10-4.2

Run # 1
Gas

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB · Bldg 716 City
Sample location Bldg 716 Boiler # 4 Date ~~26~~ 27 Apr 83
Operator Barometric pressure (P_{bar}) ~~28.80~~ in Hg 28.865

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_{f}), ml	Initial pressure mm ~~in~~ Hg			Initial temperature	
						Leg A,	Leg B,	P_i*	°F (t_i)	°R (T_i)*
1-1	Port B	0920	260	1	2085			56	75.2	
1-2	Port B	0935	330	2	2054			52	74.2	
1-3	Port A	0955	144	3	2075			55	83	
1-4	Port A	1015	153	4	2070			56	86.4	

* $P_i = P_{bar} - (A_i + B_i)$.

* $T_i = t_i + 460°F$.

Run #1
Gus

NO$_x$ Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Bldg 714 Date 28 Apr 89

Sample recovery personnel Capt Vaughn Barometric pressure, (P_{bar}) ______ in Hg

Person with direct responsibility for recovered samples ______

Sample number	Final Pressure, in. Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_i	Leg B_i	P_i[a]	°C ~~°F~~ (t_i)	°R (T_i)[b]				
1-1			725	21		1355	10	✓	
1-2			728	23		1405	10	✓	
1-3			723	24		1415	10	✓	
1-4			712	23		1420	10	✓	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

Lab person with direct responsibility for recovered samples ______

Date recovered samples received ______ Analyst ______

All samples identifiable? ______ All liquids at marked level? ______

Remarks ______

Signature of lab sample trustee ______

Fun & Gas

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Bldg 716 City ____

Sample location Boiler # 4 Date 27 Apr 89

Operator ____ Barometric pressure (P_{bar}) 28.365 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_f), ml	Initial pressure ~~in~~ mm Hg			Initial temperature	
						Leg A_i	Leg B_i	P_i[a]	°F (t_i)	°R (T_i)[b]
2-1	Port A	1110	189	5	2070			55	85	
2-2	Port A	1125	202	6	2072			56	80	
2-3	Port B	1135	172	7	2066			56	76	
2-4	Port B	1150	249	8	2070			55	87	

96

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

Run #2
Gas

NO$_x$ Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB   Date 28 Apr 89

Sample recovery personnel ________   Barometric pressure, (P_{bar}) ________ in. Hg

Person with direct responsibility for recovered samples ________

Sample number	Final Pressure, mm Hg: Leg A_f	Final Pressure, mm Hg: Leg B_f	P_f[a]	Final temperature, °C (t_f)	Final temperature, °R (T_f)[b]	Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
2-1			710	23		1435	10	✓	
2-2			712	23		1450	10	✓	
2-3			713	23		1500	10	✓	
2-4			712	23		1510	10	✓	

[a] $P_f = P_{bar} - (A_f + B_f)$

[b] $T_f = t_f + 460°F$.

Lab person with direct responsibility for recovered samples ________

Date recovered samples received ________ Analyst ________

All samples identifiable? ________ All liquids at marked level? ________

Remarks ________

Signature of lab sample trustee ________

Quality Assurance Handbook M7-4.2A

Run #3
Gruss

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Bldg 716 City

Sample location Bldg 716 Boiler # 4 Date 27 Apr 87

Operator Barometric pressure (P_{bar}) 28.865 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_f), ml	Initial pressure ~~in~~ mm Hg			Initial temperature	
						Leg A_i	Leg B_i	P_i[a]	°F (t_i)	°R (T_i)[b]
3-1	Port B	1225	319	9	2089			57	81	
3-2	Port B	1240	230	10	2080			54	88	
3-3	Port A	1300	225	11	2084			61	87	
3-4	Port A	1320	210	12	2072			55	88	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

Run #3
Gus

NO$_x$ Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Bldg 714 Date 28 Apr 88

Sample recovery personnel Capt Vaugh Barometric pressure, (P_{bar}) ________ in Hg

Person with direct responsibility for recovered samples ________

Sample number	Final Pressure, in. Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_f	Leg B_f	P_f[a]	°C ~~°F~~ (t_f)	°R (T_f)[b]				
3-1			715	23		1520	10	✓	
3-2			716	23		1535	10	✓	
3-3			704	23		1540	10	✓	
3-4			702	23		1550	10	✓	

[a] $P_f = P_{bar} - (A_f + B_f)$.

[b] $T_f = t_f + 460°F$.

Lab person with direct responsibility for recovered samples ________

Date recovered samples received ________ Analyst ________

All samples identifiable? ________ All liquids at marked level? ________

Remarks ________

Signature of lab sample trustee ________

Quality Assurance Handbook M7-4.2A

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APPENDIX F

BUILDING 716 BOILER 4

(FUEL OIL) FIELD DATA

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DETERMINATION OF MINIMUM NUMBER OF TRAVERSE POINTS

Stack ID: Bld 716 #1 Stack diameter at ports: 3.3 (ft)

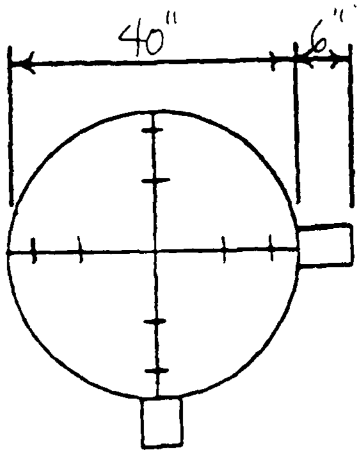
Distance A (ft) 9' (duct diameters) 2.7

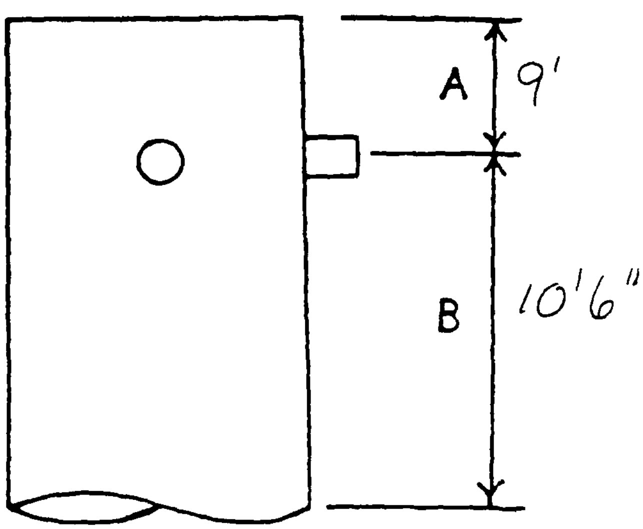
Recommended number of traverse points as determined by distance A: 12

Distance B (ft) 10' 6" (duct diameters) 3.15

Recommended number of traverse points as determined by distance B: 24

Number of traverse points used: 24





oil

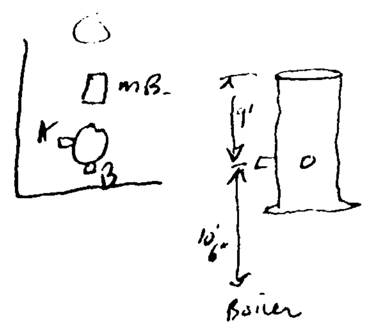
PRELIMINARY SURVEY DATA SHEET NO. 2
(Velocity and Temperature Traverse)

BASE HORTON	DATE 28 APR 89
BOILER NUMBER # 4	
INSIDE STACK DIAMETER 40	Inches
STATION PRESSURE 28.775	In Hg
STACK STATIC PRESSURE	In H20
SAMPLING TEAM (15% Moisture)	

TRAVERSE POINT NUMBER	VELOCITY HEAD, Vp IN H20	$\sqrt{V_p}$	STACK TEMPERATURE (0F)
1	.05		85
2	.07		150
3	.07		455
4	.08		~~?~~ 480
5	.075		483
6	.07		483
7	.08		484
8	.08		484
9	.07		484
10	.065		485
11	.06		485
12	.06		485
	STATIC HOH —	.11	
	FPS = 19		
	$\overline{T_s}$ = 420		
	$\overline{\Delta p}$ = 0.07		
		Nozzel = .4902	
		use = ~~.49~~ .500	
	AVERAGE		

ail

$\Delta H_{@}$ = 1.91 **PARTICULATE SAMPLING DATA SHEET** 1 of 2

RUN NUMBER	SCHEMATIC OF STACK CROSS SECTION	EQUATIONS	AMBIENT TEMP
1		$^{o}R = {}^{o}F + 460$	80 °F
DATE 28 APR 89		$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$	STATION PRESS 28.775 in Hg
PLANT bld 716		pitot tube check good.	HEATER BOX TEMP 250 °F
BASE Norton		pre leak check @ 15" Hg - good	PROBE HEATER SETTING 250
SAMPLE BOX NUMBER Nutech 2			PROBE LENGTH 72 in
METER BOX NUMBER Nutech 2		post leak check @ 8" Hg - good.	NOZZLE ~~AREA (A)~~ .500" sq ft
Qw/Qm			Cp .84
Co			DRY GAS FRACTION (Fd)

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	B 0	4.0	100		.05	2.64	837.000	86		82	231	73
2	2.5	4.0	140		.065	3.21		87		83	244	68
3	5.0	5.0	450		.07	2.29		90		84	241	63
4	7.5	5.5	480		.08	2.54		91		85	239	65
5	10.0	5.0	485		.07	2.22		95		86	240	69
6	12.5	5.0	494		.07	2.20		96		97	244	70
7	15.0	5.5	495		.08	2.52		98		88	241	71
8	17.5	5.5	494		.08	2.53		99		89	243	73
9	20.0	5.0	494		.07	2.22		101		90	241	76
10	22.5	4.0	494		.06	1.90		101		90	241	78
11	25.0	4.0	493		.06	1.91		102		92	243	80
12	27.5	4.0	494		.05	1.59		102		93	243	80
	30.0	(stop)					861.575					

START 0910

0941

OEHL FORM MAY 78 18

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER	1
DATE	28 APR 89
PLANT	bld 716
BASE	Norton
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION

see 1

EQUATIONS

$^oR = {^oF} + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

see 1

AMBIENT TEMP	80
STATION PRESS	28.775 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	72 in
NOZZLE ~~AREA (A)~~	.500" sq ft
Cp	.84
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	VAC (STATIC PRESSURE (in H2O))	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
START 0840 1	A 0	2.0	105		.02	1.07	861.577	101		94	242	82
2	2.5	2.5	180		.03	1.42		102		94	244	73
3	5.0	2.5	405		.05	1.76		102		95	241	70
4	7.5	2.5	480		.05	1.62		103		96	241	70
5	10.0	3.0	483		.05	1.62		104		97	241	70
6	12.5	3.0	491		.06	1.92		104		97	240	70
7	15.0	4.0	491		.07	2.25		105		98	241	71
8	17.5	4.5	491		.08	2.58		107		100	242	72
9	20.0	5.5	492		.10	3.22		107		100	242	74
10	22.5	6.5	492		.11	3.54		108		100	243	75
11	25.0	6.0	491		.10	3.23		108		100	240	77
12	27.5	6.0	492		.10	3.22		108		100	242	78
	30.0	(STOP)					885.706					
									96			
			$\overline{Ts}$ =	425								
			$\overline{\Delta H}$ =	2.30								
			$\overline{\sqrt{\Delta P} \, Ts}$ = 7.6731			total ft³ = 48.704						

OEHL FORM 18

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	28 APR 89	1

BUILDING NUMBER	SOURCE NUMBER
716	BOILER #4, OIL-FIRED

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.2984	.2886	.0098
ACETONE WASHINGS *(Probe, Front Half Filter)*	88.4736	88.3696	0.1040* (0.0382)
BACK HALF *(If needed)*	Ø	Ø	Ø
	Total Weight of Particulates Collected		0.0480 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	240 mls	200	40 mls
IMPINGER 2 *(H20)*	222 mls	200	22 mls
IMPINGER 3 *(Dry)*	7.9 mls	0	7.9 mls
IMPINGER 4 *(Silica Gel)*	219.8	200	19.8
	Total Weight of Water Collected		gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	10.4	10.4	10.2		10.4
VOL % O_2	4.4	4.4	4.6		4.4
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

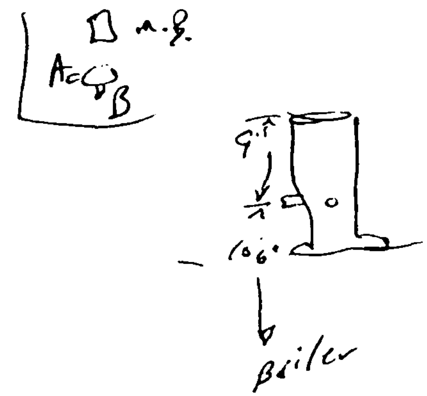
OEHL FORM MAY 78 20

* sample contaminated: used run #2 results for calculations.

(oil) $\Delta H_@ = 1.91$ 1 of 2

PARTICULATE SAMPLING DATA SHEET

RUN NUMBER: 2	SCHEMATIC OF STACK CROSS SECTION	EQUATIONS	AMBIENT TEMP: 80 °F
DATE: 28 Apr 89		$^{\circ}R = {}^{\circ}F + 460$	STATION PRESS: 28.775 in Hg
PLANT: Bld 716		$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$	HEATER BOX TEMP: 250 °F
BASE: Norton		pitot tube check – good.	PROBE HEATER SETTING: 250
SAMPLE BOX NUMBER: Nutech 2		preleak check @ 15" Hg – good.	PROBE LENGTH: 72 in
METER BOX NUMBER: Nutech 2		post leak check @ 15" Hg good	NOZZLE ~~AREA (A)~~: .500" ~~sq~~ ft
Qw/Qm			Cp: .84
Co			DRY GAS FRACTION (Fd)



TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	0	2.0	105		.025	1.35	888.680	102		101	225	87
2	2.5	2.0	140		.03	1.53		103		101	232	70
3	5.0	2.5	400		.05	1.78		104		102	235	60
4	7.5	2.5	480		.05	1.63		106		102	238	57
5	10.0	2.5	483		.05	1.63		106		102	239	56
6	12.5	2.5	483		.06	1.95		107		102	239	56
7	15.0	3.0	484		.07	2.28		108		102	241	56
8	17.5	3.5	484		.08	2.61		109		102	240	57
9	20.0	4.5	485		.10	3.26		109		103	242	57
10	22.5	5.0	486		.11	3.59		110		104	241	58
11	25.0	5.0	488		.11	3.59		112		104	243	60
12	27.5	5.0	488		.10	3.26		112		104	245	63
	30.0	(stop)					913.174					

Start 1051

1121

OEHL FORM 18 MAY 78

Oil

PARTICULATE SAMPLING DATA SHEET

2 of 2

RUN NUMBER: 2

DATE: 28 Apr 89

PLANT: bld 714

BASE: Norton

SAMPLE BOX NUMBER: Nutech 2

METER BOX NUMBER: Nutech 2

Qw/Qm:

Co:

SCHEMATIC OF STACK CROSS SECTION

see 1

EQUATIONS

$^{o}R = {}^{o}F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

See 1

AMBIENT TEMP: 80 °F

STATION PRESS: 28.775 in Hg

HEATER BOX TEMP: 250 °F

PROBE HEATER SETTING: 250

PROBE LENGTH: 72 in

NOZZLE ~~AREA~~ (A): .500" ~~sq ft~~

Cp: .84

DRY GAS FRACTION (Fd):

	TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) VAC	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
start 1125	1	0	3.0	100		.04	2.20	913.174	108		105	243	79
	2	2.5	4.5	150		.06	3.04		110		105	244	72
	3	5.0	3.5	420		.06	2.11		111		105	245	72
	4	7.5	3.5	480		.07	2.30		112		105	244	74
	5	10.0	3.5	481		.07	2.30		111		105	244	74
	6	12.5	3.0	475		.06	1.96		112		105	244	76
	7	15.0	4.5	489		.08	2.61		112		105	243	78
	8	17.5	4.5	488		.08	2.61		112		105	243	77
	9	20.0	4.0	491		.07	2.28		112		105	244	78
	10	22.5	3.5	491		.06	1.95		113		106	246	80
	11	25.0	3.0	490		.06	1.96		113		106	245	82
1155	12	27.5	3.0	486		.055	1.90		112		106	245	83
		30.0 (stop)						937.691					
										107			
				Ts =	419								
				ΔH =	2.32								
				$\sqrt{\Delta P}$ avg =	7.5915		total ft³ =		49.041				

OEHL FORM 18 MAY 78

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
HORTON	28 APR 89	2

BUILDING NUMBER	SOURCE NUMBER
716	BOILER #4, OIL-FIRED

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.3034	.2904	0.0130
ACETONE WASHINGS *(Probe, Front Half Filter)*	97.7986	98.7604	0.0382
BACK HALF *(If needed)*	Ø	Ø	Ø
	Total Weight of Particulates Collected		0.0512 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	244 mls	200	[illegible]
IMPINGER 2 *(H20)*	235 mls	200	35 mls
IMPINGER 3 *(Dry)*	8.4	0	8.4
IMPINGER 4 *(Silica Gel)*	218.5	200	18.5
	Total Weight of Water Collected		gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	10.0	10.0	[illegible]		[illegible]
VOL % O_2	4.8	4.4	4.4	4.6	4.6
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

OEHL FORM MAY 78 20

PARTICULATE SAMPLING DATA SHEET

Oil

$\Delta H_{@} = 1.91$

1 of 2

RUN NUMBER: 3

DATE: 28 Apr 87

PLANT: Htd Plt

BASE: Norton

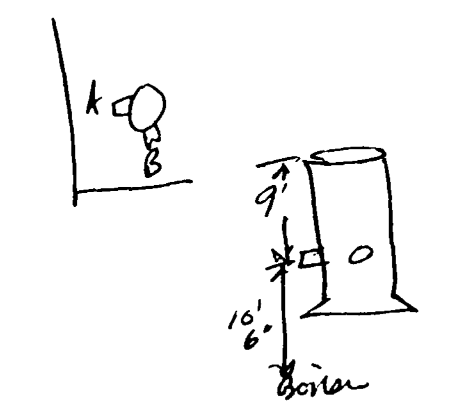
SAMPLE BOX NUMBER: Nutech 2

METER BOX NUMBER: Nutech 2

Qw/Qm: -

Co:

SCHEMATIC OF STACK CROSS SECTION



EQUATIONS

$°R = °F + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

pitot tube check - good

pre leak check @ 15" Hg - good.

post leak check @ 10" Hg - good.

AMBIENT TEMP: 80 °F

STATION PRESS: 28.775 in Hg

HEATER BOX TEMP: 250 °F

PROBE HEATER SETTING: 250

PROBE LENGTH: 72 in

NOZZLE ~~AREA (A)~~: .500' sq ft

Cp: .84

DRY GAS FRACTION (Fd):

	TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O) ΔHg	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
Start 1200	1	B 0	4.0	105		.05	2.69	938.290	98		99	228	87
	2	2.5	6.0	150		.07	3.48		98		98	232	70
	3	5.0	5.0	445		.08	2.70		103		99	237	59
	4	7.5	5.0	480		.08	2.61		107		100	238	60
	5	10.0	5.0	483		.08	2.61		109		101	246	61
	6	12.5	4.5	492		.07	2.26		110		101	241	62
	7	15.0	5.0	491		1.09	2.90		112		102	242	62
	8	17.5	5.0	496		.08	2.58		112		102	241	62
	9	20.0	4.5	495		.07	2.26		113		103	245	63
	10	22.5	4.5	494		.07	2.27		113		103	243	62
	11	25.0	4.0	493		.06	1.94		112		103	243	62
1255	12	27.5	4.0	489		.06	1.95		110		102	242	62
		30.0	(STOP)					965.152					

OEHL FORM 18 MAY 78

PARTICULATE SAMPLING DATA SHEET

2 of 2

RUN NUMBER	3
DATE	28 APR 87
PLANT	Bld 716
BASE	Norton
SAMPLE BOX NUMBER	Nutech 2
METER BOX NUMBER	Nutech 2
Qw/Qm	
Co	

SCHEMATIC OF STACK CROSS SECTION

see 1

EQUATIONS

$^{o}R = {^{o}F} + 460$

$$H = \left[\frac{5130 \cdot Fd \cdot Cp \cdot A}{Co}\right]^2 \cdot \frac{Tm}{Ts} \cdot Vp$$

see 1

AMBIENT TEMP	83 °F
STATION PRESS	28.775 in Hg
HEATER BOX TEMP	250 °F
PROBE HEATER SETTING	250
PROBE LENGTH	72 in
NOZZLE ~~AREA (A)~~	.500" ~~sq ft~~
Cp	.84
DRY GAS FRACTION (Fd)	

TRAVERSE POINT NUMBER	SAMPLING TIME (min)	STATIC PRESSURE (in H2O)	STACK TEMP (°F)	STACK TEMP (Ts) (°R)	VELOCITY HEAD (Vp)	ORIFICE DIFF. PRESS. (H)	GAS SAMPLE VOLUME (cu ft)	GAS METER TEMP IN (°F)	GAS METER TEMP AVG (Tm) (°R)	GAS METER TEMP OUT (°F)	SAMPLE BOX TEMP (°F)	IMPINGER OUTLET TEMP (°F)
1	0	3.0	105		.03	1.63	965.152	105		103	242	74
2	2.5	3.0	193		.04	1.88		107		103	242	64
3	5.0	3.5	400		.05	1.79		109		103	242	62
4	7.5	3.5	480		.06	1.97		110		103	241	61
5	10.0	3.5	485		.06	1.96		110		103	241	62
6	12.5	4.0	491		.065	2.11		111		104	244	61
7	15.0	5.0	492		.08	2.60		112		104	246	62
8	17.5	5.5	492		.09	2.92		112		104	244	62
9	20.0	6.0	495		.10	3.24		113		104	244	62
10	22.5	7.0	495		.11	3.56		113		104	243	62
11	25.0	7.0	496		.11	3.56		113		104	244	62
12	27.5	6.5	495		.10	3.24		113		104		64
	30.0 (STOP)						990.689					
									106			
			$\overline{T_s}$ =	427								
			ΔH =	2.53								
			$\sqrt{P_s T_s}$ =	8.6032								

START 1300

STOP 1330

total ft³ = 52.349

OEHL FORM 18 MAY 78

AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
NORTON	28	3

BUILDING NUMBER	SOURCE NUMBER
716	BOILER #4, OIL+FIRED

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER	.3029	.2917	0.0112
ACETONE WASHINGS *(Probe, Front Half Filter)*	97.9253	97.8571	0.0682* (0.0382)
BACK HALF *(If needed)*	∅	∅	∅
	Total Weight of Particulates Collected		0.0494 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*	399 ml	200	199 ml
IMPINGER 2 *(H20)*	216 ml	200	[illegible]
IMPINGER 3 *(Dry)*		0	1 ml
IMPINGER 4 *(Silica Gel)*	214.8	200	14.8
	Total Weight of Water Collected		gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2	8.8	9.0	9.0		9.0
VOL % O_2	4.4	4.5	4.4		[illegible]
VOL % CO					
VOL % N_2					

$$Vol\ \%\ N_2 = (100\% - \%\ CO_2 - \%\ O_2 - \%\ CO)$$

OEHL FORM 20 MAY 78

* Sample contaminated: used run #2 results for calculations.

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 28 APR 89

Sample location BLD 716 RUN 1 (Oil Fired)

Barometric pressure, mm (in.) Hg 28.775

Ambient temperature, ~~°C~~ (°F) 90 Stack temperature, ~~°C~~ (°F) 425

Intital leak check good Final leak check good

Operator Lt Ali

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		10.4	
2	1.3			
3	0.7			
4	0.9			
5	0.7			
6	0.7			
7	1.0			
8	1.0			
9	0.7			
10	0.6			
11	0.6			
12	0.6			
13	0.4			
14	0.5			
15	0.6			
16	0.6			
17	0.7			
18	0.8			
19	1.0			
20	1.3			
21	1.4			
22	1.3			
23	1.3			
24	1.3			

Quality Assurance Handbook M10-4.2

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 28 JUL 89

Sample location BLD 716 RUN 2 (Oil Fired)

Barometric pressure, mm (in.) Hg 28.775

Ambient temperature, ~~°C~~ (°F) 80 Stack temperature, ~~°C~~ (°F) 419

Intital leak check good Final leak check good

Operator Lt [illegible]

~~Clock time, 24 h~~ TRAVERSE POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		10.0	
2	1.1			
3	1.2			
4	1.2			
5	1.2			
6	1.4			
7	1.7			
8	1.9			
9	2.4			
10	2.7			
11	2.7			
12	2.4			
13	1.7			
14	2.3			
15	1.6			
16	1.7			
17	1.7			
18	1.5			
19	1.9			
20	1.9			
21	1.7			
22	1.6			
23	1.6			
24	1.5			

Quality Assurance Handbook M10-4.2

FIELD SAMPLING DATA FORM FOR CO

Plant name NORTON AFB Date 28 APR 89

Sample location BLD 716 RUN 3 (Oil Fired)

Barometric pressure, mm (in.) Hg 28.775

Ambient temperature, ~~°C~~ (°F) 80 Stack temperature, ~~°C~~ (°F) 427

Intital leak check good Final leak check good

Operator Lt AU

TRAVERSE ~~Clock time, 24 h~~ POINT	Rotameter setting, ℓ/min (ft^3/min)	CO conc, ppm (dry basis)	CO_2, %	Comments
1	1.0		9.0	
2	1.3			
3	1.0			
4	1.0			
5	1.0			
6	0.9			
7	1.1			
8	1.0			
9	0.9			
10	0.9			
11	0.8			
12	0.8			
13	0.7			
14	0.8			
15	0.8			
16	0.8			
17	0.8			
18	0.8			
19	1.0			
20	1.1			
21	1.2			
22	1.3			
23	1.3			
24	1.2			

Run #1

Oil

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Bldg 716 City ______

Sample location Bldg 716 Date 28 Apr 89

Operator ______ Barometric pressure (P_{bar}) 28.775 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_f), ml	Initial pressure ~~in.~~ mm Hg			Initial temperature	
						Leg A,	Leg B,	P_i[a]	°F (t_i)	°R (T_i)[b]
1-1	Port A	0715	290	13	~~2059~~ 2059			54	85	
1-2	Port A	0930	325	14	2080			56	82	
1-3	Port B	0945	335	15	2082			57	80	
1-4	Port B	1005	210	16	2043			55	80	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

Run #1
0.1

NO_x Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Bldg 716 Date 29 Apr 87

Sample recovery personnel ________ Barometric pressure, (P_{bar}) ________ in. Hg

Person with direct responsibility for recovered samples Capt Vaughn

Sample number	Final Pressure, mm ~~in.~~ Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_1	Leg B_1	P_1[a]	°C ~~°F~~ (t_1)	°R (T_1)[b]				
1-1			712	20		0855	10	✓	
1-2			711	20		0910	10	✓	
1-3			711	20		0920	10	✓	
1-4			712	20		0925	10	✓	

[a] $P_1 = P_{bar} - (A_1 + B_1)$.

[b] $T_1 = t_1 + 460°F$.

Lab person with direct responsibility for recovered samples ________

Date recovered samples received ________ Analyst ________

All samples identifiable? ________ All liquids at marked level? ________

Remarks ________

Signature of lab sample trustee ________

Quality Assurance Handbook M7-4.2A

Run #2
Oil

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Bldg 716 City
Sample location Bldg 716 Date 28 Apr 88
Operator Barometric pressure (P_{bar}) [illegible] 775 in Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_f), ml	Initial pressure mm ~~in.~~ Hg			Initial temperature	
						Leg A,	Leg B,	P_i*	°F (t_i)	°R (T_i)[b]
2-1	Port B	1105	300	17	2066			60	84	
2-2	Port B	1120	390	18	2074			57	88	
2-3	Port A	1140	290	19	2061			59	88	
2-4	Port A	1155	275	20	2102			64	91	

*$P_i = P_{bar} - (A_i + B_i)$.

[b]$T_i = t_i + 460°F$.

Run # 2

Oil

NO$_x$ Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Bldg 716 Date 29 Apr 89

Sample recovery personnel Capt Vaughn Barometric pressure, (P_{bar}) ____ in. Hg

Person with direct responsibility for recovered samples ____

Sample number	Final Pressure, mm ~~in.~~ Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_1	Leg B_1	P_1[a]	°C ~~°F~~ (t_1)	°R (T_1)[b]				
2-1			708	20		0935	10	✓	
2-2			705	20		0945	10	✓	
2-3			696	20		0955	10	✓	
2-4			692	20		1005	10	✓	

[a] $P_1 = P_{bar} - (A_1 + B_1)$.

[b] $T_1 = t_1 + 460°F$.

Lab person with direct responsibility for recovered samples ____

Date recovered samples received ____ Analyst ____

All samples identifiable? ____ All liquids at marked level? ____

Remarks ____

Signature of lab sample trustee ____

Run #3
0:1

Nitrogen Oxide Field Data Form
(English units)

Plant Norton AFB Bldg 716 City

Sample location Bldg 716 Date 28 Apr 89

Operator Barometric pressure (P_{bar}) 28.775 in. Hg

Sample number	Sample point location	Sample time 24-hr	Probe temperature, °F	Flask and valve number	Volume of flask and valve (V_f), ml	Initial pressure mm ~~in.~~ Hg			Initial temperature	
						Leg A_i	Leg B_i	P_i[a]	°F (t_i)	°R (T_i)[b]
3-1	Port A	1225	220	21	2080			60	93	
3-2	Port A	1245	236	22	2062			63	94	
3-3	Port B	1305	320	26	2059 ~~2086~~			64	91	
3-4	Port B	1320	330	27	2059			63	86	

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[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

Run #3
0.1

NO_x Sample Recovery and Integrity Data Form
(English units)

Plant Norton AFB Bldg 716 Date 29 Apr 89

Sample recovery personnel ______ Barometric pressure, (P_{bar}) ______ in. Hg

Person with direct responsibility for recovered samples ______

Sample number	Final Pressure, mm ~~in.~~ Hg			Final temperature,		Sample recovery time, 24-h	pH adjusted 9 to 12	Liquid level marked	Samples stored in locked container
	Leg A_i	Leg B_i	P_i[a]	°C ~~°F~~ (t_i)	°R (T_i)[b]				
3-1			700	20		1020	10	✓	
3-2			696	20		1030	10	✓	
3-3			698	20		1040	10	✓	
3-4			701	22		1050	10	✓	

[a] $P_i = P_{bar} - (A_i + B_i)$.

[b] $T_i = t_i + 460°F$.

Lab person with direct responsibility for recovered samples ______

Date recovered samples received ______ Analyst ______

All samples identifiable? ______ All liquids at marked level? ______

Remarks ______

Signature of lab sample trustee ______

APPENDIX G

ACETONE BLANK RESULTS

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AIR POLLUTION PARTICULATE ANALYTICAL DATA

BASE	DATE	RUN NUMBER
Norton AFB	03 MAY 89	Acetone Blank

BUILDING NUMBER	SOURCE NUMBER

I. PARTICULATES

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT PARTICLES (gm)
FILTER NUMBER			
ACETONE WASHINGS *(Probe, Front Half Filter)*	103.7766	103.7776	(-) .0010
BACK HALF *(If needed)*			
	Total Weight of Particulates Collected		(-) .0010 gm

II. WATER

ITEM	FINAL WEIGHT (gm)	INITIAL WEIGHT (gm)	WEIGHT WATER (gm)
IMPINGER 1 *(H20)*			
IMPINGER 2 *(H20)*			
IMPINGER 3 *(Dry)*			
IMPINGER 4 *(Silica Gel)*			
	Total Weight of Water Collected		gm

III. GASES *(Dry)*

ITEM	ANALYSIS 1	ANALYSIS 2	ANALYSIS 3	ANALYSIS 4	AVERAGE
VOL % CO_2					
VOL % O_2					
VOL % CO					
VOL % N_2					

Vol % N_2 = (100% - % CO_2 - % O_2 - % CO)

AMD FORM FEB 84 651 REPLACES OEHL 20, MAY 78, WHICH IS OBSOLETE.

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APPENDIX H

EMISSIONS CALCULATIONS

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```
XROM "METH 5"
RUN NUMBER
BOILER, BLDG 672, RUN 1
                        RUN
METER BOX Y?
             1.0020     RUN
DELTA H?
             3.0500     RUN
BAR PRESS ?
            28.7300     RUN
METER VOL ?
            56.5540     RUN
MTR TEMP F?
           108.0000     RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                        RUN
STATIC HOH IN ?
              .1100     RUN
STACK TEMP.
           392.0000     RUN
ML. WATER ?
           114.9000     RUN
IMP. % HOH = 9.6

% HOH=9.6


% CO2?
             4.3000     RUN
% OXYGEN?
            13.7000     RUN
% CO ?
                        RUN
MOL WT OTHER?
                        RUN

MWd =29.24
MW WET=28.16


SQRT PSTS ?
             7.7461     RUN
TIME MIN ?
            60.0000     RUN
NOZZLE DIA ?
              .4990     RUN
STK DIA INCH ?
            24.0000     RUN

* VOL MTR STD = 50.976
  STK PRES ABS = 28.74
  VOL HOH GAS = 5.41
  % MOISTURE = 9.59
  MOL DRY GAS = 0.904
  % NITROGEN = 82.00
  MOL WT DRY = 29.24
  MOL WT WET = 28.16
  VELOCITY FPS = 19.55
  STACK AREA = 3.14
  STACK ACFM = 3,686.
  STACK DSCFM = 1,984.
  % ISOKINETIC = 99.14
```

```
XROM "METH 5"
RUN NUMBER
BOILER, BLDG 672, RUN 2
                        RUN
METER BOX Y?
             1.0020     RUN
DELTA H?
             2.6100     RUN
BAR PRESS ?
            28.7300     RUN
METER VOL ?
            52.9330     RUN
MTR TEMP F?
           105.0000     RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                        RUN
STATIC HOH IN ?
              .1100     RUN
STACK TEMP.
           401.0000     RUN
ML. WATER ?
           120.1000     RUN
IMP. % HOH = 10.6

% HOH=10.6


% CO2?
             7.0000     RUN
% OXYGEN?
             8.6000     RUN
% CO ?
                        RUN
MOL WT OTHER?
                        RUN

MWd =29.46
MW WET=28.25


SQRT PSTS ?
             7.4475     RUN
TIME MIN ?
            60.0000     RUN
NOZZLE DIA ?
              .4990     RUN
STK DIA INCH ?
            24.0000     RUN

* VOL MTR STD = 47.912
  STK PRES ABS = 28.74
  VOL HOH GAS = 5.65
  % MOISTURE = 10.55
  MOL DRY GAS = 0.894
  % NITROGEN = 84.40
  MOL WT DRY = 29.46
  MOL WT WET = 28.25
  VELOCITY FPS = 18.77
  STACK AREA = 3.14
  STACK ACFM = 3,538.
* STACK DSCFM = 1,964.
  % ISOKINETIC = 99.1[illegible]
```

```
XROM "METH 5"
RUN NUMBER
BOILER, BLDG 672, RUN 3
                        RUN
METER BOX Y?
             1.0020     RUN
DELTA H?
             2.4400     RUN
BAR PRESS ?
            28.7300     RUN
METER VOL ?
            51.3830     RUN
MTR TEMP F?
           112.0000     RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                        RUN
STATIC HOH IN ?
              .1100     RUN
STACK TEMP.
           389.0000     RUN
ML. WATER ?
           139.6000     RUN
IMP. % HOH = 12.5

% HOH=12.5


% CO2?
             7.0000     RUN
% OXYGEN?
             9.0000     RUN
% CO ?
                        RUN
MOL WT OTHER?
                        RUN

MWd =29.48
MW WET=28.04


SQRT PSTS ?
             7.1904     RUN
TIME MIN ?
            60.0000     RUN
NOZZLE DIA ?
              .4990     RUN
STK DIA INCH ?
            24.0000     RUN

* VOL MTR STD = 45.920
  STK PRES ABS = 28.74
  VOL HOH GAS = 6.57
  % MOISTURE = 12.52
  MOL DRY GAS = 0.875
  % NITROGEN = 84.00
  MOL WT DRY = 29.48
  MOL WT WET = 28.04
  VELOCITY FPS = 18.19
  STACK AREA = 3.14
  STACK ACFM = 3,429.
* STACK DSCFM = 1,79[illegible].
  % ISOKINETIC = 9[illegible].[illegible]7
```

```
XROM "MASSFLO"

RUN NUMBER
BOILER, BLDG 672, RUN 1
                     RUN

VOL MTR STD ?

         50.9760    RUN
STACK DSCFM ?
      1,984.0000    RUN
FRONT 1/2 MG ?
           .0109    RUN
BACK 1/2 MG ?
          0.0000    RUN


F  GR/DSCF = 3.2998E-6
F  MG/MMM = 0.0076
F  LB/HR = 0.0001
F  KG/HR = 2.5454E-5
```

```
XROM "MASSFLO"

RUN NUMBER
BOILER BLDG 672, RUN 2
                     RUN

VOL MTR STD ?
         47.9120    RUN
STACK DSCFM ?
      1,864.0000    RUN
FRONT 1/2 MG ?
           .0067    RUN
BACK 1/2 MG ?
          0.0000    RUN


F  GR/DSCF = 2.1580E-6
F  MG/MMM = 0.0049
F  LB/HR = 3.4479E-5
F  KG/HR = 1.5640E-5
```

```
XROM "MASSFLO"

RUN NUMBER
BOILER, BLDG 672, RUN 3
                     RUN

VOL MTR STD ?
         45.9200    RUN
STACK DSCFM ?
      1,792.0000    RUN
FRONT 1/2 MG ?
           .0068    RUN
BACK 1/2 MG ?
          0.0000    RUN


F  GR/DSCF = 2.2852E-6
F  MG/MMM = 0.0052
F  LB/HR = 3.5101E-5
F  KG/HR = 1.5922E-5
```

```
XROM "METH 5"
RUN NUMBER
BOILER 1, BLD 249, RUN 1
                    RUN
METER BOX Y?
          1.0020    RUN
DELTA H?
          1.6500    RUN
BAR PRESS ?
         28.7050    RUN
METER VOL ?
         41.3510    RUN
MTR TEMP F?
         78.0000    RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                    RUN
STATIC HOH IN ?
           .0500    RUN
STACK TEMP.
        369.0000    RUN
ML. WATER ?
        100.6000    RUN
IMP. % HOH = 10.8

% HOH=10.8

% CO2?
          6.0000    RUN
% OXYGEN?
          9.8000    RUN
% CO ?
                    RUN
MOL WT OTHER?
                    RUN

MWd =29.35
MW WET=28.13

SQRT PSTS ?
         10.3360    RUN
TIME MIN ?
         60.0000    RUN
NOZZLE DIA ?
           .3750    RUN
STK DIA INCH ?
         19.0000    RUN

* VOL MTR STD = 39.[illegible]
  STK PRES ABS = 28.71
  VOL HOH GAS = 4.74
  % MOISTURE = 10.78
  MOL DRY GAS = 0.892
  % NITROGEN = 84.20
  MOL WT DRY = 29.35
  MOL WT WET = 28.13
  VELOCITY FPS = 26.13
  STACK AREA = 1.97
  STACK ACFM = 3,0[illegible]
* STACK DSCFM = [illegible]
  % ISOKINETIC = [illegible]
```

```
XROM "METH 5"
RUN NUMBER
BOILER 1, BLD 249, RUN 2
                    RUN
METER BOX Y?
          1.0020    RUN
DELTA H?
          1.6000    RUN
BAR PRESS ?
         28.7050    RUN
METER VOL ?
         40.5920    RUN
MTR TEMP F?
         87.0000    RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                    RUN
STATIC HOH IN ?
           .0500    RUN
STACK TEMP.
        377.0000    RUN
ML. WATER ?
        128.6000    RUN
IMP. % HOH = 13.8

% HOH=13.8

% CO2?
          5.2000    RUN
% OXYGEN?
         10.6000    RUN
% CO ?
                    RUN
MOL WT OTHER?
                    RUN

MWd =29.26
MW WET=27.70

SQRT PSTS ?
         10.2150    RUN
TIME MIN ?
         60.0000    RUN
NOZZLE DIA ?
           .3750    RUN
STK DIA INCH ?
         19.0000    RUN

* VOL MTR STD = 37.820
  STK PRES ABS = 28.71
  VOL HOH GAS = 6.05
  % MOISTURE = 13.80
  MOL DRY GAS = 0.862
  % NITROGEN = 84.20
  MOL WT DRY = 29.26
  MOL WT WET = 27.70
  VELOCITY FPS = 26.01
  STACK AREA = 1.97
  STACK ACFM = 3,07[illegible]
* STACK DSCFM = 1,60[illegible]
  % ISOKINETIC = 100.9[illegible]
```

```
XROM "METH 5"
RUN NUMBER
BOILER 1, BLD 249, RUN 3
                    RUN
METER BOX Y?
          1.0020    RUN
DELTA H?
          1.6000    RUN
BAR PRESS ?
         28.7050    RUN
METER VOL ?
         42.0440    RUN
MTR TEMP F?
         86.0000    RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                    RUN
STATIC HOH IN ?
           .0500    RUN
STACK TEMP.
        377.0000    RUN
ML. WATER ?
        149.7000    RUN
IMP. % HOH = 15.2

% HOH=15.2

% CO2?
          5.6000    RUN
% OXYGEN?
          9.8000    RUN
% CO ?
                    RUN
MOL WT OTHER?
                    RUN

MWd =29.29
MW WET=27.57

SQRT PSTS ?
         10.2806    RUN
TIME MIN ?
         60.0000    RUN
NOZZLE DIA ?
           .3750    RUN
STK DIA INCH ?
         19.0000    RUN

* VOL MTR STD = 39.245
  STK PRES ABS = 28.71
  VOL HOH GAS = 7.05
  % MOISTURE = 15.22
  MOL DRY GAS = 0.848
  % NITROGEN = 84.60
  MOL WT DRY = 29.29
  MOL WT WET = 27.57
  VELOCITY FPS = 26.24
  STACK AREA = 1.97
  STACK ACFM = 3,10[illegible]
* STACK DSCFM = 1,5[illegible]
  % ISOKINETIC = 105.[illegible]
```

XROM "MASSFLO"

RUN NUMBER
BOILER 1, BLD 249, RUN 1
RUN

VOL MTR STD ?
39.1770 RUN
STACK DSCFM ?
1,682.0000 RUN
FRONT 1/2 MG ?
.0059 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 2.3241E-6
F MG/MMM = 0.0053
F LB/HR = 3.3506E-5
F KG/HR = 1.5198E-5

XROM "MASSFLO"

RUN NUMBER
BOILER Z, BLD 249, RUN 2
RUN

VOL MTR STD ?
37.8200 RUN
STACK DSCFM ?
1,603.0000 RUN
FRONT 1/2 MG ?
.0040 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 1.6322E-6
F MG/MMM = 0.0037
F LB/HR = 2.2426E-5
F KG/HR = 1.0172E-5

XROM "MASSFLO"

RUN NUMBER
BOILER 1, BLD 249, RUN 3
RUN

VOL MTR STD ?
39.2450 RUN
STACK DSCFM ?
1,591.0000 RUN
FRONT 1/2 MG ?
.0040 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 1.5729E-6
F MG/MMM = 0.0036
F LB/HR = 2.1450E-5
F KG/HR = 9.7296E-6

NATURAL GAS RUN

```
XROM "METH 5"
RUN NUMBER
BOIL. 4, BLD 716, RUN 1
                    RUN
METER BOX Y?
          1.0020    RUN
DELTA H?
          2.4500    RUN
BAR PRESS ?
         28.8650    RUN
METER VOL ?
         49.7940    RUN
MTR TEMP F?
         83.0000    RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                    RUN
STATIC HOH IN ?
           .0450    RUN
STACK TEMP.
        449.0000    RUN
ML. WATER ?
        208.9000    RUN
IMP. % HOH = 17.3

% HOH=17.3

% CO2?
          9.0000    RUN
% OXYGEN?
          4.0000    RUN
% CO ?
                    RUN
MOL WT OTHER?
                    RUN

MWd =29.60
MW WET=27.60

SQRT PSTS ?
          7.8857    RUN
TIME MIN ?
         60.0000    RUN
NOZZLE DIA ?
           .5000    RUN
STK DIA INCH ?
         40.0000    RUN

* VOL MTR STD = 47.097
  STK PRES ABS = 28.87
  VOL HOH GAS = 9.83
  % MOISTURE = 17.27
  MOL DRY GAS = 0.827
  % NITROGEN = 87.00
  MOL WT DRY = 29.60
  MOL WT WET = 27.60
  VELOCITY FPS = 20.06
  STACK AREA = 8.73
  STACK ACFM = 10,5[illegible].
* STACK DSCFM = 4,[illegible].
  % ISOKINETIC = 103.2[illegible]
```

```
XROM "METH 5"
RUN NUMBER
BOIL. 4, BLD 716, RUN 2
                    RUN
METER BOX Y?
          1.0020    RUN
DELTA H?
          2.6400    RUN
BAR PRESS ?
         28.8650    RUN
METER VOL ?
         53.7810    RUN
MTR TEMP F?
         95.0000    RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                    RUN
STATIC HOH IN ?
           .0450    RUN
STACK TEMP.
        404.0000    RUN
ML. WATER ?
        202.0000    RUN
IMP. % HOH = 16.0

% HOH=16.0

% CO2?
          7.0000    RUN
% OXYGEN?
          5.8000    RUN
% CO ?
                    RUN
MOL WT OTHER?
                    RUN

MWd =29.35
MW WET=27.53

SQRT PSTS ?
          7.6686    RUN
TIME MIN ?
         60.0000    RUN
NOZZLE DIA ?
           .5000    RUN
STK DIA INCH ?
         40.0000    RUN

* VOL MTR STD = 49.792
  STK PRES ABS = 28.87
  VOL HOH GAS = 9.51
  % MOISTURE = 16.03
  MOL DRY GAS = 0.840
  % NITROGEN = 87.20
  MOL WT DRY = 29.35
  MOL WT WET = 27.53
  VELOCITY FPS = 19.53
  STACK AREA = 8.73
  STACK ACFM = 10,228.
* STACK DSCFM = 5,064.
  % ISOKINETIC = 104.[illegible]
```

```
XROM "METH 5"
RUN NUMBER
BOIL. 4, BLD 716, RUN 3
                    RUN
METER BOX Y?
          1.0020    RUN
DELTA H?
          2.6000    RUN
BAR PRESS ?
         28.8650    RUN
METER VOL ?
         51.7660    RUN
MTR TEMP F?
        102.0000    RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                    RUN
STATIC HOH IN ?
           .0450    RUN
STACK TEMP.
        436.0000    RUN
ML. WATER ?
        209.4000    RUN
IMP. % HOH = 17.2

% HOH=17.2

% CO2?
          9.0000    RUN
% OXYGEN?
          3.0000    RUN
% CO ?
                    RUN
MOL WT OTHER?
                    RUN

MWd =29.56
MW WET=27.57

SQRT PSTS ?
          7.8698    RUN
TIME MIN ?
         60.0000    RUN
NOZZLE DIA ?
           .5000    RUN
STK DIA INCH ?
         40.0000    RUN

* VOL MTR STD = 47.324
  STK PRES ABS = 28.87
  VOL HOH GAS = 9.86
  % MOISTURE = 17.24
  MOL DRY GAS = 0.828
  % NITROGEN = 88.00
  MOL WT DRY = 29.56
  MOL WT WET = 27.57
  VELOCITY FPS = 20.03
  STACK AREA = 8.73
  STACK ACFM = 10,499.
* STACK DSCFM = 4,535.
  % ISOKINETIC = 10[illegible]
```

XROM "MASSFLO"

RUN NUMBER
BOIL. 4, BLD 716, RUN 1
RUN

VOL MTR STD ?
47.0970 RUN
STACK DSCFM ?
4,871.0000 RUN
FRONT 1/2 MG ?
.0138 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 4.5218E-6
F MG/MMM = 0.0103
F LB/HR = 0.0002
F KG/HR = 0.0001

XROM "MASSFLO"

RUN NUMBER
BOIL. 4, BLD 716, RUN 2
RUN

VOL MTR STD ?
49.7920 RUN
STACK DSCFM ?
5,064.0000 RUN
FRONT 1/2 MG ?
.0088 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 2.7274E-6
F MG/MMM = 0.0062
F LB/HR = 0.0001
F KG/HR = 0.0001

XROM "MASSFLO"

RUN NUMBER
BOIL. 4, BLD 716, RUN 3
RUN

VOL MTR STD ?
47.3240 RUN
STACK DSCFM ?
4,936.0000 RUN
FRONT 1/2 MG ?
.0086 RUN
BACK 1/2 MG ?
0.0000 RUN

F GR/DSCF = 2.8044E-6
F MG/MMM = 0.0064
F LB/HR = 0.0001
F KG/HR = 0.0001

FUEL OIL RUN

```
XROM "METH 5"
RUN NUMBER
BOIL. 4, OIL RUN 1
                    RUN
METER BOX Y?
         1.0020     RUN
DELTA H?
         2.3000     RUN
BAR PRESS ?
        28.7750     RUN
METER VOL ?
        48.7040     RUN
MTR TEMP F?
        96.0000     RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                    RUN
STATIC HOH IN ?
          .1100     RUN
STACK TEMP.
       425.0000     RUN
ML. WATER ?
        87.7000     RUN
IMP. % HOH = 8.4

% HOH=8.4


% CO2?
        10.4000     RUN
% OXYGEN?
         4.4000     RUN
% CO ?
                    RUN
MOL WT OTHER?
                    RUN

MWd =29.84
MW WET=28.84


SQRT PSTS ?
         7.6731     RUN
TIME MIN ?
        60.0000     RUN
NOZZLE DIA ?
          .5000     RUN
STK DIA INCH ?
        40.0000     RUN

* VOL MTR STD = 44.832
  STK PRES ABS = 28.78
  VOL HOH GAS = 4.13
  % MOISTURE = 8.43
  MOL DRY GAS = 0.916
  % NITROGEN = 85.20
  MOL WT DRY = 29.84
  MOL WT WET = 28.84
  VELOCITY FPS = 19.12
  STACK AREA = 8.73
  STACK ACFM = 10,013.
* STACK DSCFM = 5,263.
  % ISOKINETIC =  90.97
```

```
XROM "METH 5"
RUN NUMBER
BOIL. 4, OIL RUN 2  RUN
METER BOX Y?
         1.0020     RUN
DELTA H?
         2.3200     RUN
BAR PRESS ?
        28.7750     RUN
METER VOL ?
        49.0410     RUN
MTR TEMP F?
       107.0000     RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                    RUN
STATIC HOH IN ?
          .1100     RUN
STACK TEMP.
       419.0000     RUN
ML. WATER ?
       105.9000     RUN
IMP. % HOH = 10.1

% HOH=10.1


% CO2?
        10.0000     RUN
% OXYGEN?
         4.5500     RUN
% CO ?
                    RUN
MOL WT OTHER?
                    RUN

MWd =29.78
MW WET=28.59


SQRT PSTS ?
         7.5915     RUN
TIME MIN ?
        60.0000     RUN
NOZZLE DIA ?
          .5000     RUN
STK DIA INCH ?
        40.0000     RUN

* VOL MTR STD = 44.269
  STK PRES ABS = 28.78
  VOL HOH GAS = 4.98
  % MOISTURE = 10.12
  MOL DRY GAS = 0.899
  % NITROGEN = 85.45
  MOL WT DRY = 29.78
  MOL WT WET = 28.59
  VELOCITY FPS = 19.00
  STACK AREA = 8.73
  STACK ACFM = 9,951.
* STACK DSCFM = 5,168.
  % ISOKINETIC =  91.43
```

```
XROM "METH 5"
RUN NUMBER
BOIL. 4, OIL RUN 3
                    RUN
METER BOX Y?
         1.0020     RUN
DELTA H?
         2.5300     RUN
BAR PRESS ?
        28.7750     RUN
METER VOL ?
        52.3490     RUN
MTR TEMP F?
       106.0000     RUN
% OTHER GAS
REMOVED BEFORE
DRY GAS METER ?
                    RUN
STATIC HOH IN ?
          .1100     RUN
STACK TEMP.
       427.0000     RUN
ML. WATER ?
       150.8000     RUN
IMP. % HOH = 13.0

% HOH=13.0


% CO2?
         9.0000     RUN
% OXYGEN?
         4.4000     RUN
% CO ?
                    RUN
MOL WT OTHER?
                    RUN

MWd =29.62
MW WET=28.10


SQRT PSTS ?
         8.0032     RUN
TIME MIN ?
        60.0000     RUN
NOZZLE DIA ?
          .5000     RUN
STK DIA INCH ?
        40.0000     RUN

* VOL MTR STD = 47.364
  STK PRES ABS = 28.78
  VOL HOH GAS = 7.10
  % MOISTURE = 13.03
  MOL DRY GAS = 0.870
  % NITROGEN = 86.60
  MOL WT DRY = 29.62
  MOL WT WET = 28.10
  VELOCITY FPS = 20.21
  STACK AREA = 8.73
  STACK ACFM = 10,561.
* STACK DSCFM = 5,269.
  % ISOKINETIC =  95.97
```

```
XROM "MASSFLO"

RUN NUMBER
BOIL. 4, OIL 716 RUN 3
                     RUN

VOL MTR STD ?
       47.3640    RUN
STACK DSCFM ?
    5,269.0000    RUN
FRONT 1/2 MG ?
         .0494    RUN
BACK 1/2 MG ?
        0.0000    RUN

F  GR/DSCF = 1.6095E-5
F  MG/MMM = 0.0368
F  LB/HR = 0.0007
F  KG/HR = 0.0003
```

```
XROM "MASSFLO"

RUN NUMBER
BOIL. 4, OIL 716 RUN 2
                     RUN

VOL MTR STD ?
       44.2690    RUN
STACK DSCFM ?
    5,168.0000    RUN
FRONT 1/2 MG ?
         .0512    RUN
BACK 1/2 MG ?
        0.0000    RUN

F  GR/DSCF = 1.7848E-5
F  MG/MMM = 0.0408
F  LB/HR = 0.0008
F  KG/HR = 0.0004
```

```
XROM "MASSFLO"

RUN NUMBER
BOIL. 4, OIL 716 RUN 1
                     RUN

VOL MTR STD ?
       44.8320    RUN
STACK DSCFM ?
    5,263.0000    RUN
FRONT 1/2 MG ?
         .0480    RUN
BACK 1/2 MG ?
        0.0000    RUN

F  GR/DSCF = 1.6523E-5
F  MG/MMM = 0.0378
F  LB/HR = 0.0007
F  KG/HR = 0.0003
```

LABORATORY ANALYSIS REPORT AND RECORD (General)

DATE: 16 May 89

TO:

FROM: USAFOEHL/SA
BROOKS AFB TX 78235-5501

SAMPLE IDENTITY: GY890017 thru GY890028, air samples

DATE RECEIVED: 9 May 89

SAMPLE FROM: B/672

LAB CONTROL NR: 26503 thru 26514

TEST FOR: Carbon Monoxide

METHODOLOGY: Infrared Spectrograph, ED X-ray; Gas Chromatograph; Other: Gas Cell
closed cup Flash Pt. Tester: pH measurement; Atomic Absorption

OEHL NO	BASE NO	RESULTS PPM
26503	890017	10
26504	890018	10
26505	890019	10
26506	890020	<10
26507	890021	<10
26508	890022	<10
26509	890023	65
26510	890024	10
26511	890025	570
26512	890026	<10
26513	890027	<10
26514	890028	<10

REQUESTING AGENCY (Mailing Address)

AFOEHL/ECQ
Capt Vaughn

J D Hillsberry

J.D. HILLSBERRY, GS-12
Chief, Industrial Products and
Compressed Gas Analyses Section

AFSC Form 3511, DEC 85 REPLACES AMD FORM 64, SEP 62 WHICH IS OBSOLETE

CARBON MONOXIDE CALCULATION FORM

Plant NORTON AFB Date 20 MAY 89

Sample location BLD 672

Test number 1, 2, 3

Bag number GN890017, GN890018, GN890019

Operator LT ALI

CO Concentration

$C_{CO_{NDIR}}$ = 10, 10, 10 ppm (dry basis).

F_{CO_2} = 4.3, 7.0, 7.0 % ÷ 100 = .043, .07, .07

$C_{CO_{stack}} = C_{CO_{NDIR}} (1 - F_{CO_2})$.

= 10, 10, 10 (1 - .043, .07, .07) = 9.57, 9.3, 9.3 ppm (dry basis).

AVERAGE CO CONCENTRATION = 9.39 ppm (dry basis).

Errors:

CARBON MONOXIDE CALCULATION FORM

Plant NORTON AFB Date 20 MAY '89

Sample location BLD 249

Test number 1, 2, 3

Bag number GN890020, GN890021, GN890022

Operator LT [illegible]

CO Concentration

$C_{CO_{NDIR}}$ = 10, 10, 10 ppm (dry basis).

F_{CO_2} = 6.0, 5.2, 5.6 % ÷ 100 = .06, .052, .056.

$C_{CO_{stack}} = C_{CO_{NDIR}} (1 - F_{CO_2})$.

= 10, 10, 10 (1 - 0.06, .052, .056) = 9.4, 9.48, 9.44 ppm (dry basis).

AVERAGE CO CONCENTRATION = 9.44 ppm (dry basis).

Errors:

CARBON MONOXIDE CALCULATION FORM

Plant NORTON AFB Date 20 MAY 89

Sample location BLD 716 (GAS FIRED)

Test number 1, 2, 3

Bag number GN890023, GN890024, GN890025

Operator CT ALI

CO Concentration

65, 10, 570

$C_{CO_{NDIR}}$ = _ _ _ ppm (dry basis).

9.0, 7.0, 9.0 0.09, .07, .09

F_{CO_2} = _ _ . _ % ÷ 100 = 0._ _.

$C_{CO_{stack}} = C_{CO_{NDIR}} (1 - F_{CO_2})$.

65, 10, 570 .090, .070, .090 59.15, 9.30, 518.7

= _ _ _ (1 - 0._ _ _) = _ _ _ ppm (dry basis).

AVERAGE CO CONCENTRATION: 195. ppm (dry basis).

Errors:

CARBON MONOXIDE CALCULATION FORM

Plant Noxton AFB Date 28 APR 89

Sample location BLD 716 (Oil Fired)

Test number 1, 2, 3

Bag number GN 890026, GN 890027, GN 890028

Operator LT Ali

CO Concentration

$C_{CO_{NDIR}}$ = <10, <10, <10 ppm (dry basis).

F_{CO_2} = 10.4, 10.0, 9.0 % ÷ 100 = 0.104, .100, .090

$C_{CO_{stack}} = C_{CO_{NDIR}} (1 - F_{CO_2})$.

= 10, 10, 10 (1 - 0.104, .100, .090) = 8.96, 9.00, 9.10 ppm (dry basis).

AVERAGE CO CONCENTRATION: 9.02

Errors:

LABORATORY ANALYSIS REPORT AND RECORD (General)	DATE 29 JUN 1989
TO:	FROM:
SAMPLE IDENTITY Air/Impinger Solution	DATE RECEIVED 11 MAY 89
SAMPLE FROM BLDG 672	LAB CONTROL NR 27125 - 174
TEST FOR Nitrogen Oxides	

REFERENCED METHOD: Method #7, 42 CFR, #160, Part II
ANALYSIS DATE: June 8, 1989

LAB #	OEHL #	BASE #	ANALYTICAL RESULTS (μg NO_2)
Quantitation Limit			100
89-05-294-01	27125	GX890029	130
89-05-294-02	27126	GX890030	140
89-05-294-03	27127	GX890031	140
89-05-294-04	27128	GX890032	170
89-05-294-05	27129	GX890033	150
89-05-294-06	27130	GX890034	140
89-05-294-07	27131	GX890035	110
89-05-294-08	27132	GX890036	140
89-05-294-09	27133	GX890037	110
89-05-294-10	27134	GX890038	150
89-05-294-11	27135	GX890039	130
89-05-294-12	27136	GX890040	120
89-05-294-13	27137	GX890041	120
89-05-294-14	27138	GX890042	130
89-05-294-15	27139	GX890043	120
89-05-294-16	27140	GX890044	150
89-05-294-17	27141	GX890045	140
89-05-294-18	27142	GX890046	140
89-05-294-19	27143	GX890047	130
89-05-294-20	27145	GX890049	150
89-05-294-21	27146	GX890050	150
89-05-294-22	27148	GX890052	150
89-05-294-23	27149	GX890053	270
89-05-294-24	27150	GX890054	290
89-05-294-25	27151	GX890055	240
89-05-294-26	27152	GX890056	220
89-05-294-27	27153	GX890057	150

REQUESTING AGENCY (Mailing Address)

AFOEHL /ECQ

ATT CAPT VAUGHN

Analyzed by Biospherics Incorporated

LABORATORY ANALYSIS REPORT AND RECORD (General)		DATE
TO:	FROM:	
SAMPLE IDENTITY Air/Impinger Solution		DATE RECEIVED
SAMPLE FROM		LAB CONTROL NR
TEST FOR Nitrogen Oxides		

REFERENCED METHOD: Method #7, 42 CFR, #160, Part II
ANALYSIS DATE: June 8, 1989

LAB #	OEHL #	BASE #	ANALYTICAL RESULTS ($\mu g\ NO_2$)
Quantitation Limit			100
89-05-294-28	27154	GX890058	200
89-05-294-29	27155	GX890059	210
89-05-294-30	27156	GX890060	190
89-05-294-31	27157	GX890061	200
89-05-294-32	27158	GX890062	190
89-05-294-33	27159	GX890063	170
89-05-294-34	27160	GX890064	150
89-05-294-35	27161	GX890065	320
89-05-294-36	27162	GX890066	410
89-05-294-37	27163	GX890067	450
89-05-294-38	27164	GX890068	330
89-05-294-39	27165	GX890069	380
89-05-294-40	27166	GX890070	340
89-05-294-41	27167	GX890071	310
89-05-294-42	27168	GX890072	370
89-05-296-01	27169	GX890073	340
89-05-296-02	27170	GX890074	350
89-05-296-03	27171	GX890075	340
89-05-296-04	27172	GX890076	400
89-05-296-05	27173	BK890077	*
89-05-296-06	27174	BK890078	*

*Sample broken during analysis.

Andrew Richardson III
ANDREW RICHARDSON, III, GS-12
Chief, IH Analysis Section

REQUESTING AGENCY (Mailing Address)

Analyzed by Biospherics Incorporated

1342CHEM 2

[redacted]

1. Nitrogen Concentration Calculations

A. Calculation for sample volume, dry basis, corrected to standard conditions:

$$V_{sc} = K_1 \, (V_f - 25\ \text{ml}) \left(\frac{P_f}{T_f} - \frac{P_i}{T_i} \right)$$

where:

$$K_1 = 0.3858 \ \ \text{K} / \text{mm Hg}$$

B. Sample concentration, dry basis, corrected to standard conditions:

$$C = K_2 \, \frac{m}{V_{sc}}$$

where:

$$K_2 = 10^3 \, \frac{\text{mg/m}^3}{\text{ug/ml}}$$

units:

- m = mass of NO_2 as NO_2 in gas sample, ug.
- P_f = final absolute pressure of flask, mm Hg.
- P_i = initial absolute pressure of flask, mm Hg.
- P_{std} = standard absolute pressure, 760 mm Hg.
- T_f = final absolute temperature of flask, K.
- T_i = initial absolute temperature of flask, K.
- T_{std} = standard absolute temperature, 293 K.
- V_{sc} = sample volume at standard conditions (dry basis), ml.
- V_f = volume of flask and valve, ml.

Bldg. 672

Run - Sample	Vf	Pf	Pi	Tf	Ti	Vsc
1 - 1	2085	682	62	295	314	1,680
1 - 2	2085	718	72	295	314	1,752
1 - 3	2054	711	70	295	320	1,715
1 - 4	2075	682	60	295	319	1,679
2 - 1	2090	677	62	294	320	1,680
2 - 2	2072	685	65	295	320	1,673
2 - 3	2066	682	64	295	319	1,662
2 - 4	2070	689	61	295	317	1,690
3 - 1	2089	678	59	295	316	1,681
3 - 2	2080	680	72	296	317	1,641
3 - 3	2084	680	71	296	320	1,648
3 - 4	2072	674	72	296	321	1,621

Bldg. 672

Run - Sample	Vsc	m	C
1 - 1	1,680	130	41
1 - 2	1,752	140	42
1 - 3	1,715	140	43
1 - 4	1,679	170	53
		ave	45
2 - 1	1,680	150	47
2 - 2	1,673	140	44
2 - 3	1,662	110	35
2 - 4	1,690	140	44
		ave	42
3 - 1	1,681	110	34
3 - 2	1,641	150	48
3 - 3	1,648	130	41
3 - 4	1,621	120	39
		ave	41

Average of 3 runs 43

Bldg. 249

Run - Sample	Vf	Pf	Pi	Tf	Ti	Vsc
1 - 1	2059	707	55	290	295	1,766
1 - 2	2080	708	56	291	296	1,778
1 - 3	2082	712	54	291	296	1,796
1 - 4	2043	715	53	291	297	1,773
2 - 1	2066	699	58	291	299	1,738
2 - 2	2074	694	61	292	299	1,717
2 - 3	2061	716	54	292	301	1,785
2 - 4	2102	711	61	293	297	1,779
3 - 1	2080	696	56	292	305	1,744
3 - 2	2062	695	58	292	301	1,719
3 - 3	2086	704	57	292	302	1,766
3 - 4	2066	716	53	292	295	1,789

Bldg. 249

Run - Sample	Vsc	m	C
1 - 1	1,766	120	36
1 - 2	1,778	130	38
1 - 3	1,796	120	35
1 - 4	1,773	150	44
		ave	38
2 - 1	1,738	140	42
2 - 2	1,717	140	43
2 - 3	1,785	130	38
2 - 4	1,779	135	40
		ave	41
3 - 1	1,744	150	45
3 - 2	1,719	150	46
3 - 3	1,766	150	45
3 - 4	1,789	150	44
		ave	45

average of 3 runs 41

Bldg. 716 Gas

Run - Sample	Vf	Pf	Pi	Tf	Ti	Vsc
1 - 1	2085	725	56	294	297	1,809
1 - 2	2054	728	52	296	296	1,787
1 - 3	2075	723	55	297	301	1,780
1 - 4	2070	712	56	296	303	1,751
2 - 1	2090	710	55	296	302	1,765
2 - 2	2072	712	56	296	300	1,752
2 - 3	2066	713	56	296	297	1,748
2 - 4	2070	712	55	296	304	1,755
3 - 1	2089	715	59	296	300	1,766
3 - 2	2080	716	54	296	304	1,776
3 - 3	2084	704	61	296	305	1,730
3 - 4	2072	702	55	296	304	1,730

Bldg. 716 gas

Run - Sample	Vsc	m	C
1 - 1	1,809	270	79
1 - 2	1,787	290	86
1 - 3	1,780	240	71
1 - 4	1,751	220	66
		ave	75
2 - 1	1,765	150	45
2 - 2	1,752	200	60
2 - 3	1,748	210	63
2 - 4	1,755	190	57
		ave	56
3 - 1	1,766	200	60
3 - 2	1,776	190	56
3 - 3	1,730	170	52
3 - 4	1,730	150	46
		ave	53

average of 3 runs 62

Bldg. 716 Oil

Run - Sample	Vf	Pf	Pi	Tf	Ti	Vsc
1 - 1	2059	712	54	293	302	1,766
1 - 2	2080	711	56	293	301	1,776
1 - 3	2082	711	57	293	300	1,774
1 - 4	2043	712	55	293	300	1,749
2 - 1	2066	708	60	293	302	1,746
2 - 2	2074	705	57	293	304	1,753
2 - 3	2061	696	59	293	304	1,713
2 - 4	2102	692	64	293	306	1,724
3 - 1	2080	700	60	293	307	1,739
3 - 2	2062	696	63	293	307	1,705
3 - 3	2059	698	64	293	306	1,705
3 - 4	2059	701	63	295	303	1.701

Bldg 716 oil

Run - Sample	Vsc	m	C
1 - 1	1,766	320	96
1 - 2	1,776	410	122
1 - 3	1,774	450	134
1 - 4	1,749	330	100
		ave	113
2 - 1	1,746	380	115
2 - 2	1,753	340	103
2 - 3	1,713	310	96
2 - 4	1,724	370	114
		ave	107
3 - 1	1,739	340	103
3 - 2	1,705	350	109
3 - 3	1,705	340	105
3 - 4	1,701	400	124
		ave	110

average of 3 runs 110

SERIAL # 11000903

ENERAC MODEL 2000

COMBUSTION TEST RECORD

FOR: WESTINGHOUSE CA.

TIME: 12:52:16
DATE: 04/28/89

FUEL #2 OIL: 19360 BTU/LB

COMBUSTION EFFICIENCY:	93.7	%
AMBIENT TEMPERATURE:	92	°F
STACK TEMPERATURE:	112	°F
OXYGEN:	006.0	%
CARBON MONOXIDE:	30	PPM
CARBON DIOXIDE:	11.3	%
COMBUSTIBLE GASES:	0.00	%
STACK DRAFT (INCHES H2O):	+ 00.0	
EXCESS AIR:	36	%
OXIDES of NITROGEN:	120	PPM
SULFUR DIOXIDE:	32	PPM
CARBON MONOXIDE ALARM:	600	PPM

MODE:PPM OXY_REF=TRUE%

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APPENDIX I

CALIBRATION DATA

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STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

NUTECH #2

Date 3 JAN 89 Thermocouple number INLET/OUTLET

Ambient temperature 26 °C Barometric pressure ______ in. Hg

Calibrator GARRISON SCOTT Reference: mercury-in-glass ASTM 63F

other ______

Reference point number	Source[a] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[b] ≤ °C *
INLET				
–	HOT WATER BATH	43.5	43	.5
–	ROOM TEMP	26	26	0
OUTLET				
–	HOT WATER BATH	43.5	42	1
-	ROOM TEMP	26	26.5	.5

[a]Type of calibration system used.

[b] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%.$

Quality Assurance Handbook M5-2.5

* MUST BE WITHIN 3°C OF REFERENCE

#6L

Pitot tube assembly level? ✓ **yes** ____ **no**

Pitot tube openings damaged? ____ **yes (explain below)** ✓ **no**

α_1 = Ø ° (<10°), α_2 = Ø ° (<10°), β_1 = 0 ° (<5°),

β_2 = 1 ° (<5°)

γ = 3 °, θ = Ø °, A = 29/32 [redacted] in.

z = A sin γ = .Ø47 [redacted] (in.); <0.32 cm (<1/8 in.),

w = A sin θ = Ø [redacted] (in.); <.08 cm (<1/32 in.)

P_A 29/64 [redacted] in. P_b 29/64 [redacted] in.

D_t = .375 [redacted] in.

Comments: CONSTRUCTED THRU 40 CFR 60, APP A, METH 2 FIG 2.2 ASSIGNED BASELINE COEFFICIENT = 0.84

Calibration required? ____ yes ✓ no

Quality Assurance Handbook M2-1.7

TYPE S PITOT TUBE INSPECTION DATA FORM

#6B

Pitot tube assembly level? ✓ **yes** ______ **no**

Pitot tube openings damaged? ______ **yes (explain below)** ✓ **no**

α_1 = 0 ° (<10°), α_2 = 0 ° (<10°), β_1 = 0 ° (<5°),

β_2 = 1 ° (<5°)

(1.0625)

γ = 0 °, θ = 0 °, A = 1 1/16 ~~cm~~ (in.)

z = A sin γ = 0.0 ~~cm~~ (in.); <0.32 cm (<1/8 in.),

w = A sin θ = 0.0 ~~cm~~ (in.); <.08 cm (<1/32 in.)
0.0313

P_A 17/32 (0.53) ~~cm~~ (in.) P_b 17/32 (0.53) ~~cm~~ (in.)

D_t = 0.375 ~~cm~~ (in.)

Comments: CONSTRUCTED IAW 40 CFR 60, APP A, METH 2, FIG 2.2. ASSIGNED BASELINE COEFFICIENT = 0.84

Calibration required? ______ yes ✓ no

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date 19/20 OCT 88 Thermocouple number IMPINGER D3

Ambient temperature 26 °C Barometric pressure 29.232/ 29.175 in. Hg

Calibrator GARRISON/ SCOTT Reference: mercury-in-glass NBS

other ____

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] ~~%~~ °C*
C	ICE BATH	0	0.6	0.6
—	ROOM TEMP	25.8	25.6	0.2

[a]Every 30°C (50°F) for each reference point.

[b]Type of calibration system used.

[c]$\left[\dfrac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%.$

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date ~~19~~ 20 OCT 88 Thermocouple number IMPINGER D2

Ambient temperature 26° °C Barometric pressure ~~29.175~~ 29.232 in. Hg

Calibrator GARRISON/ SCOTT Reference: mercury-in-glass NBS

other ______

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] ~~%~~ °C *
0	ICE BATH	0	0	—
—	ROOM TEMP	26.0	26.6	0.6

[a]Every 30°C (50°F) for each reference point.

[b]Type of calibration system used.

[c] $\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%.$

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK TEMPERATURE SENSOR CALIBRATION DATA FORM

Date ~~19~~ 20 OCT 88 Thermocouple number IMPINGER D1

Ambient temperature 26 °C Barometric pressure ~~29.175~~ 29.232 in. Hg

Calibrator GARRISON/SCOTT Reference: mercury-in-glass NBS

other ______

Reference point number[a]	Source[b] (specify)	Reference thermometer temperature, °C	Thermocouple potentiometer temperature, °C	Temperature difference,[c] ~~%~~ °C *
0	ICE BATH	0	0	—
—	ROOM TEMP	25.5	26.1	0.6

[a]Every 30°C (50°F) for each reference point.

[b]Type of calibration system used.

[c]$\left[\frac{(\text{ref temp, °C} + 273) - (\text{test thermom temp, °C} + 273)}{\text{ref temp, °C} + 273}\right] 100 \leq 1.5\%$.

* MUST BE WITHIN 1°C OF REF

Quality Assurance Handbook M2-2.10

STACK SENSOR CALIBRATION: 19-20 Oct 88

SENSOR #	REFERENCE TEMPERATURE (deg K) X axis	TEST TEMPERATURE (deg K) Y axis
P1	273.30	273.60
	371.90	373.60
	447.00	450.20
P2	273.30	273.60
	371.80	373.60
	447.60	450.80
P3	273.30	274.10
	371.90	374.10
	447.60	450.80
P4	273.30	273.60
	371.80	373.60
	447.60	450.80

P1 Regression Output:

Constant		-4.30
Std Err of Y Est		0.20
R Squared		1.00
No. of Observations		3.00
Degrees of Freedom		1.00
X Coefficient(s)	1.02	
Std Err of Coef.	0.00	

% Deviation @ 2000 F(1093.3 K) = 1.29%

P2 Regression Output:

Constant		-4.27
Std Err of Y Est		0.11
R Squared		1.00
No. of Observations		3.00
Degrees of Freedom		1.00
X Coefficient(s)	1.02	
Std Err of Coef.	0.00	

% Deviation @ 2000 F(1093.3 K) = 1.25%

P3 Regression Output:

Constant		-2.96
Std Err of Y Est		0.03
R Squared		1.00
No. of Observations		3.00
Degrees of Freedom		1.00
X Coefficient(s)	1.01	
Std Err of Coef.	0.00	

% Deviation @ 2000 F(1093.3 K) = 1.11%

P4 Regression Output:

Constant		-4.27
Std Err of Y Est		0.11
R Squared		1.00
No. of Observations		3.00
Degrees of Freedom		1.00
X Coefficient(s)	1.02	
Std Err of Coef.	0.00	

% Deviation @ 2000 F(1093.3 K) = 1.27%

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test numbers ________ Date 22 Mar 89 Meter box number Nutech 2 Plant Post Eglin/Pre Norton

Barometric pressure, P_b = 29.520 in. Hg Dry gas meter number Nutech 2 Pretest Y 1.002

Orifice manometer setting, (ΔH), in. H_2O	Gas volume		Temperature				Time (θ), min	Vacuum setting, in. Hg	Y_i	Y_i
	Wet test meter (V_w), ft^3	Dry gas meter (V_d), ft^3	Wet test meter (t_w), °F	Dry gas meter						$\frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
				Inlet (t_{d_i}), °F	Outlet (t_{d_o}), °F	Average[a] (t_d), °F				
.90	10	9.594	76 78 =77	89 84 81.5	75 77 76.4	78.75	18.67	10.0	1.043	(10)(29.52)(538.75) / (9.594)(29.52 + .9/13.6)(537)
.90	10	9.626	76 78 -78	84 86 85.4	77 79 78.4	81.50	18.71	10.0	1.043	(10)(29.52)(541.5) / (9.626)(29.586)(538)
.90	10	9.671	77 76 -76.5	86 87 86.5	77 80 79.5	83.40	18.75	10.0	1.044	(10)(29.52)(543) / (9.671)(29.5862)(536.5)
									Y = 1.043	

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d.

V_w = Gas volume passing through the wet test meter, ft^3. Y=1.002

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F. .9519 ⟷ 1.6521

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in H_2O.

Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y $\pm$0.05Y

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

ATTEBERY/VAUGHN

POSTTEST DRY GAS METER CALIBRATION DATA FORM (English units)

Test number ________ Date 12 MAY 89 Meter box number Nutech 2 Plant Port Norton

Barometric pressure, P_b = 29.065 in. Hg Dry gas meter number ________ Pretest Y 1.002

Orifice manometer setting, (ΔH), in. H_2O	Gas volume: Wet test meter (V_w), ft^3	Gas volume: Dry gas meter (V_d), ft^3	Temperature: Wet test meter (t_w), °F	Temperature: Dry gas meter: Inlet (t_{d_i}), °F	Temperature: Dry gas meter: Outlet (t_{d_o}), °F	Temperature: Dry gas meter: Average[a] (t_d), °R	Time (θ), min	Vacuum setting, in. Hg	Y_i	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d \left(P_b + \frac{\Delta H}{13.6}\right)(t_w + 460)}$
2.0	10	10.100	76 75 75	76 81	77 79	543.5	13.25	8.0	1.0008	10(29.065)(543.5) / (10.100)(29.065 + 2/13.6)(535)
2.0	10	10.146	75 75 75	81 71	79 81	545.0	13.28	8.0	.9990	10(29.065)(545) / 10.146(29.065 + 2/13.6)(535)
2.0	10	10.176	75 75 75	71 72	81 82	546.5	13.30	8.0	.9988	10(29.065)(546.5) / 10.176(29.065 + 2/13.6)(535)
									Y = .9995	ok

TOLERANCE
0.9519 < Y < 1.0521

[a] If there is only one thermometer on the dry gas meter, record the temperature under t_d

where

V_w = Gas volume passing through the wet test meter, ft^3.

V_d = Gas volume passing through the dry gas meter, ft^3.

t_w = Temperature of the gas in the wet test meter, °F.

t_{d_i} = Temperature of the inlet gas of the dry gas meter, °F.

t_{d_o} = Temperature of the outlet gas of the dry gas meter, °F.

t_d = Average temperature of the gas in the dry gas meter, obtained by the average of t_{d_i} and t_{d_o}, °F.

ΔH = Pressure differential across orifice, in. H_2O.

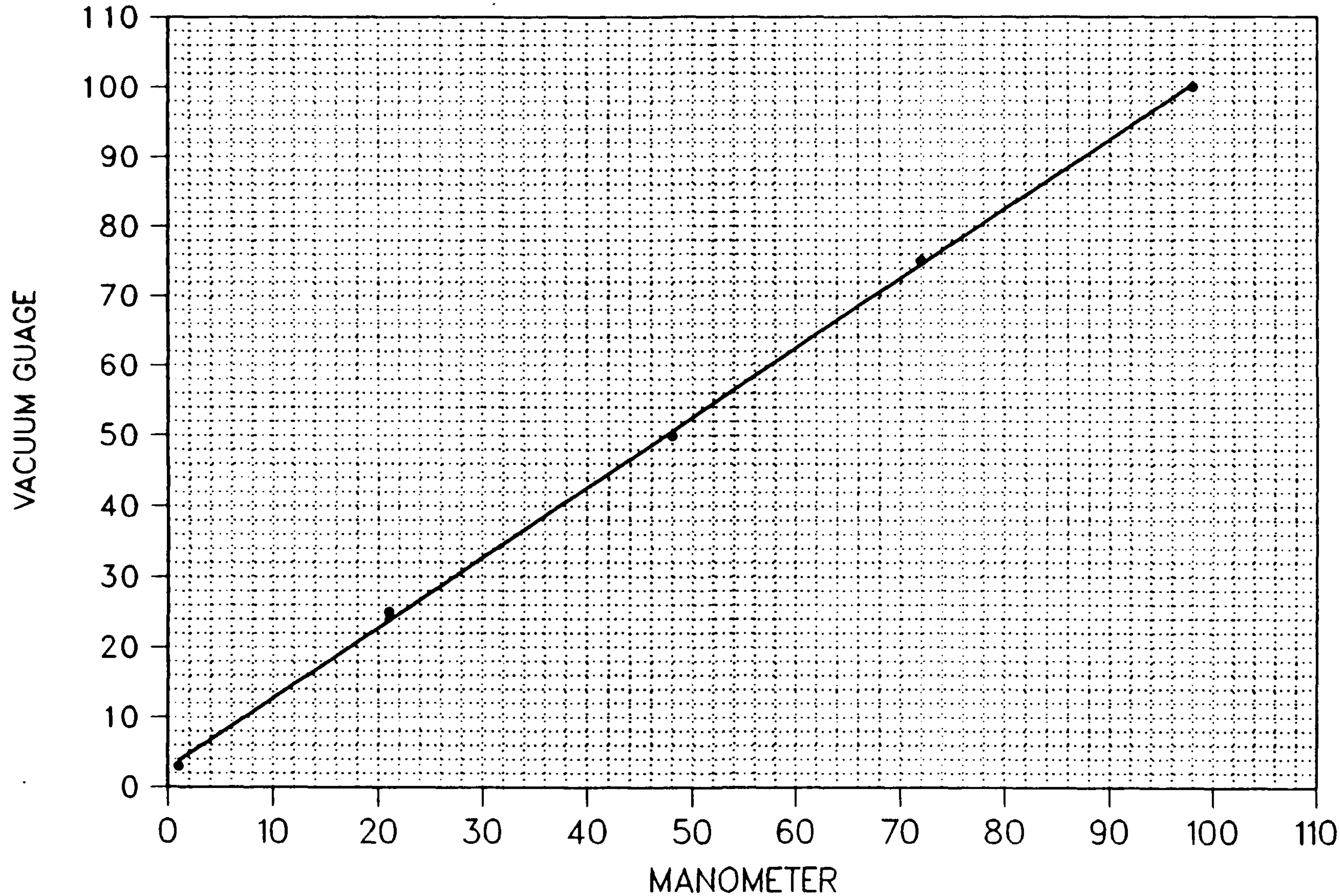
Y_i = Ratio of accuracy of wet test meter to dry gas meter for each run.

Y = Average ratio of accuracy of wet test meter to dry gas meter for all three runs; tolerance = pretest Y ± 0.05Y.

P_b = Barometric pressure, in. Hg.

θ = Time of calibration run, min.

VACUUM GUAGE CALIBRATION (inches of Hg)



VACUUM GAUGE mm. Hg	MANOMETER mm. Hg			DELTA
	Leg A	Leg B	P	
3	828	90	1	2
25	818	100	21	4
50	805	114	48	2
75	793	126	72	3
100	780	139	98	2

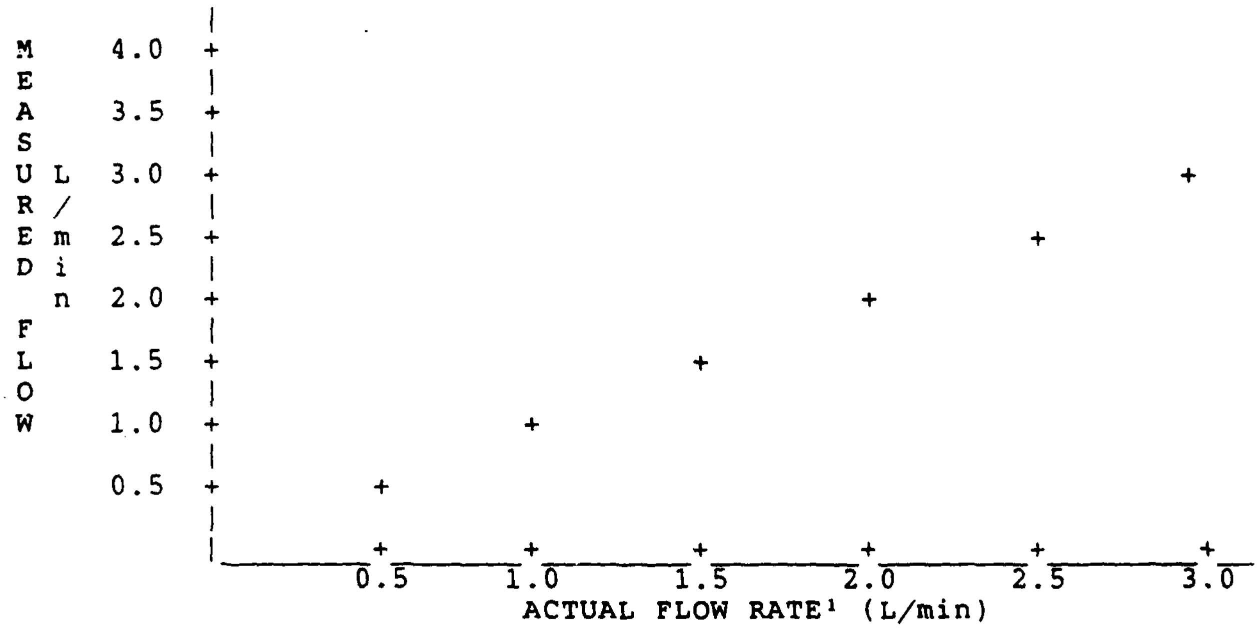
Barometric Pressure 739 mm Hg

VOLUMES OF NOX FLASKS WITH VALVES

(ml)

1)	2085	17)	2066
2)	2054	18)	2074
3)	2075	19)	2061
4)	2070	20)	2102
5)	2090	21)	2080
6)	2072	22)	2062
7)	2066	23)	2086
8)	2070	24)	2066
9)	2089	25)	2070
10)	2080	26)	2059
11)	2084	27)	2059
12)	2072	28)	2083
13)	2059	29)	2065
14)	2080	30)	2063
15)	2082	31)	2074
16)	2043	32)	2086

Calibration of Rotometer



note: [1] = Buck Bubble Tube Calibrator used to establish actual flow rate.

NOZZLE CALIBRATION DATA FORM

Date 19 APR 89 Calibrated by JAMES GARRISON

Nozzle identification number	Nozzle Diameter[a] D_1, mm (in.)	D_2, mm (in.)	D_3, mm (in.)	ΔD,[b] mm (in.)	D_{avg}[c]
#6	.498	.500	.499	.002	.499
#3	.375	.376	.375	.001	.375
#6	.499	.499	.501	.002	.500

where:

[a] $D_{1,2,3}$, = three different nozzles diameters, mm (in.); each diameter must be within (0.025 mm) 0.001 in.

[b] ΔD = maximum difference between any two diameters, mm (in.), $\Delta D \leq$ (0.10 mm) 0.004 in.

[c] D_{avg} = average of D_1, D_2, and D_3.

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